



# **3<sup>rd</sup> INDIAN ANALYTICAL CONGRESS IAC-2024**

**AN INTERNATIONAL ANALYTICAL  
CONFERENCE AND EXHIBITION**

**05-07<sup>th</sup> June, 2024**

**Venue: CSIR-IIP, Dehradun, Uttarakhand-India**

**ABSTRACT BOOK  
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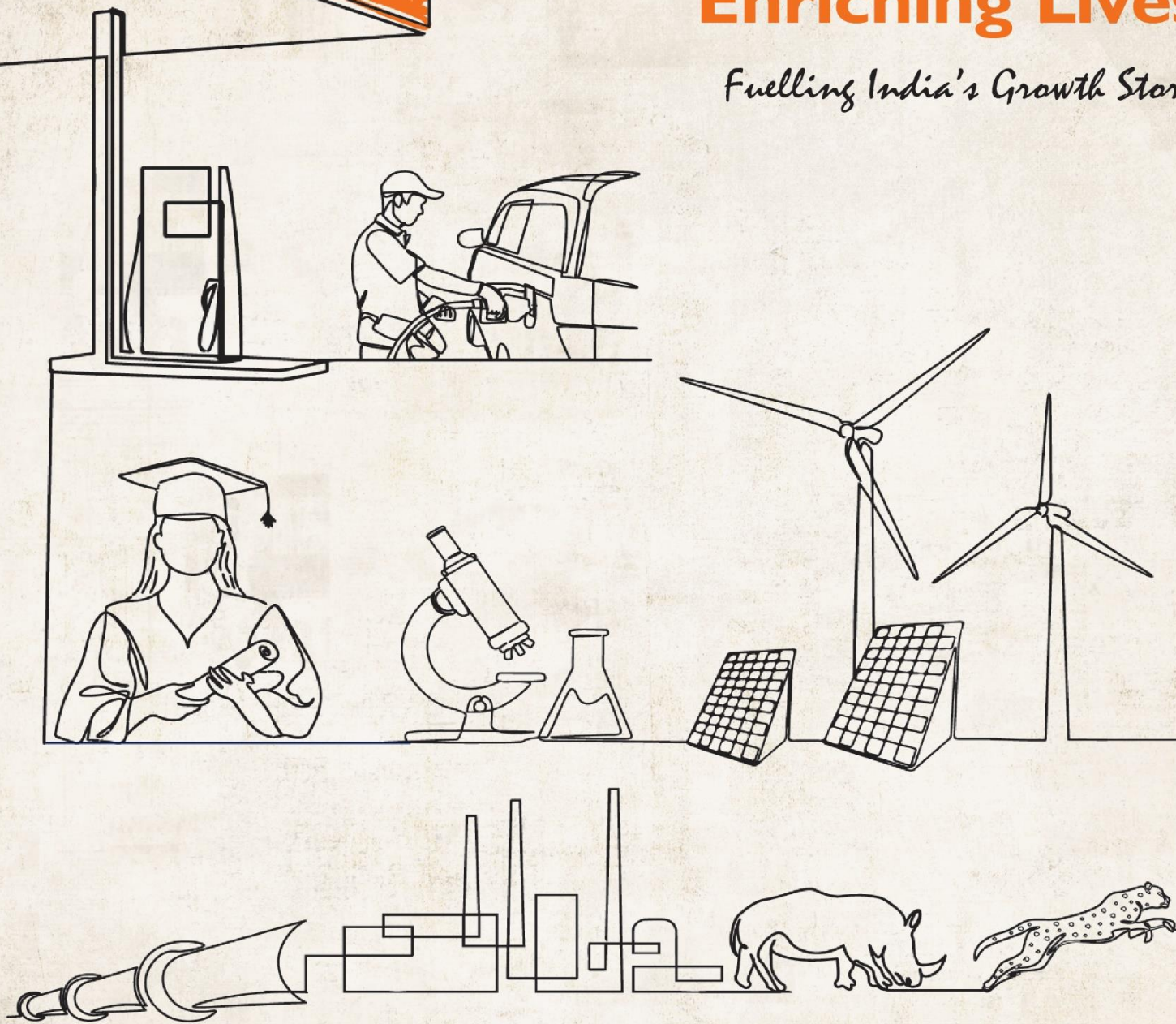
**Role of Science &  
Technology In Green  
Transitions**

*Jointly organized by*

**Indian Society of Analytical Scientists (ISAS)–Delhi Chapter &  
CSIR-Indian Institute of Petroleum Dehradun**

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## **MESSAGE FROM CHIEF PATRON**

I am glad to learn that the ISAS-Delhi Chapter jointly with Indian Institute of Petroleum (IIP) Dehradun is organizing 3rd Indian Analytical Congress (IAC-2024) - An International Analytical Conference & Exhibition at CSIR-IIP Dehradun during June 5-7, 2024. Analytical techniques play a crucial role in contemporary society, particularly in select sectors where a thorough and up-to-date understanding of this field is imperative. Analytical science is focused on generating fresh insights to enhance chemical analysis, thereby meeting evolving or heightened demands. The strategic importance of Analytical Chemistry lies in its status as an information-centric discipline, indispensable to the fabric of modern society. Scientists and scholars require a broad comprehension of analytical methodologies to validate their theoretical frameworks and translate them into empirically substantiated discoveries.

Analytical chemistry remains integral to our technical pursuits, serving not only scientists and engineers but also facilitating translational and interdisciplinary endeavors spanning disciplines such as biology, medical science, and even the social sciences (e.g., economists involved in circular economy and bio-economy initiatives). Coupled with the transformative potential of Industry 4.0, facilitated by the Internet of Things, artificial intelligence, and automation, numerous promising avenues emerge for the analytical sciences.

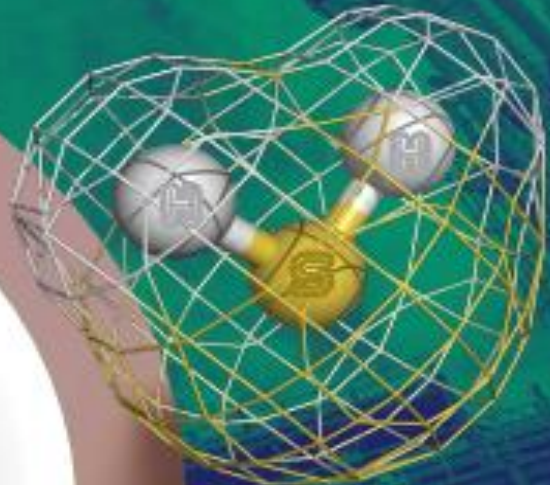
I am confident that IAC 2024 will offer a platform for all participants to acquaint themselves with the latest advancements in this dynamic field. This year's theme, "Role of Science & Technology in Green Transitions," underscores the challenges confronting both industry and academia, emphasizing the need for enhanced precision and accuracy while targeting increasingly stringent detection limits. IAC-2024 endeavors to foster a dialogue between the research community, academia, and industry, crucial for addressing future imperatives, including initiatives in circular economy to mitigate climate change and minimize environmental waste. I extend my warmest greetings to the dignitaries, delegates, exhibitors, and benefactors of IAC-2024 for the successful conference and key-learning.

**Alok Sharma**  
**Chief Patron, ISAS DC & Director (R&D)- IOCL**

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## **MESSAGE FROM DIRECTOR CSIR-IIP**

I extend my warm welcome to all the participants of the 3<sup>rd</sup> Indian Analytical Congress (IAC 2024), jointly organized by the Indian Society of Analytical Scientists (ISAS) and CSIR-Indian Institute of Petroleum (CSIR-IIP) during 5<sup>th</sup>-7<sup>th</sup> June 2024 at CSIR-IIP, Dehradun.

The world today is in a dilemma due to the ever-increasing energy demand and the requirement of minimizing greenhouse gas emissions. Science & Technology is going to play a key role in managing this contradiction. The transition to green technologies requires intense R&D efforts, not only in process and material development but also in analytical method development. Over the years analytical scientists have contributed immensely towards the development of fast and reliable analytical techniques leading to the development of new products and processes. With the green transition, the role of analytical scientists becomes even more important.

I am sure that the deliberations at the conference would immensely benefit the research community and will lead to new pathways to realize the green transition. The conference would offer excellent networking opportunities for industry and academia leading to fruitful outcomes. I wish the conference a grand success.

With Best Wishes

**(Harender Singh Bisht)**  
**Director-CSIR-IIP**

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## **MESSAGE FROM CHAIRMAN – ORGANIZING COMMITTEE**

I take immense pleasure to welcome you all to 3<sup>rd</sup> **Indian Analytical Congress (IAC-2024)- An International Analytical Conference & Exhibition** jointly organized by Indian Society of Analytical Scientists-Delhi Chapter (ISAS-DC) and CSIR-Indian Institute of Petroleum (IIP), Dehradun being held at CSIR-IIP, Dehradun during 5-7 June 2024.

IAC-2024 being organized with the Theme “Role of Science & Technology in Green Transition” is dovetail with the World Environment Day-2024 on 5<sup>th</sup> June’24 and resonate with the global concerns on environment and sustainability. This Analytical Conference will bring galaxy of eminent speakers from the field of Petrochemicals, Drugs & Pharmaceuticals, Life Sciences, Agricultural & Food Industries, Environmental & Forest and Geology, as well as researchers, scientists, research scholars, industry experts, equipment manufacturers on a common platform and share their latest research work. I hope the deliberation during this conference will be highly beneficial to industry, academia and student’s community.

On behalf of Executive Committee of ISAS-DC, I would like to express my sincere appreciation and thanks to the organizing committee for their efforts. I wish this conference a great success and hope you will have a great time and stay at Dehradun.

**Dr. G S Kapur**  
**Chairman -Organizing Committee of IAC-2024**  
**Former Executive Director (R&D), Indian Oil Corporation Ltd**

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## **MESSAGE FROM CHAIRMAN-ISAS DC**

I am very glad that Indian Society of Analytical Scientists – Delhi Chapter in association with Indian Institute of Petroleum (CSIR-IIP) is organizing **Indian Analytical Congress (IAC-2024) from June 5 to 7, 2024 at Indian Institute of Petroleum, Dehradun, India** with the theme **“Role of Science & Technology in Green Transition”**.

The International Analytical Conference and Exhibition aims to provide a forum for the researchers from Academia and Industry, working in the areas of green and low carbon chemicals, petroleum, petrochemicals, drug & pharmaceutical, food & agricultural, environmental, climatic change etc., to share their knowledge, latest cutting-edge research findings and associated aspects of Analytical Science.

**ISAS-Delhi Chapter** ([www.isasdelhi.org](http://www.isasdelhi.org)), since its inception, provides a common platform for analytical scientists to exchange ideas, keep themselves abreast of the latest developments, thus promoting growth of analytical sciences in the country. Over the years, ISAS-Delhi Chapter has organized more than 60 programs in various parts of northern India. We have received overwhelming response for the 3 days Indian Analytical Congress (IAC-2024). More than 300 delegates are expected to participate in IAC-2024 from India & abroad and more than 250 abstracts have been received for Plenary, Invited, Oral and Poster sessions. Our esteemed sponsors have also extended their wholehearted financial support for the event.

On behalf of the Executive Committee of ISAS-Delhi Chapter, I extend a very warm welcome to all the authors, delegates, sponsors & exhibitors of IAC-2024. I hope the deliberation during this conference will be highly beneficial to industry, academia and student's community. I would like to express my sincere appreciation and thanks to the organizing committee for their efforts and I wish this conference a great success.

**(Dr. J. Christopher)**  
**Chairman, ISAS-Delhi Chapter**  
**Ex.Chief General Manager, IOC R&D**



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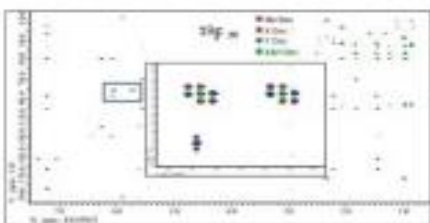
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## **MESSAGE FROM CONVENER**

It is my privilege and honor to welcome you all to the on behalf of organizing committee of the Indian Analytical Congress (IAC-2024) and Indian Society of Analytical Science-Delhi Chapter (ISAS-DC) Joint conference under the auspices of the CSIR-IIP Dehradun & Indian Society of Analytical Science-Delhi Chapter (ISAS-DC). The main goal of organizing this conference is to share and enhance the knowledge of each and every individual in this fast-moving Information Era. We have given a good opportunity for those who have a thirst for knowing the present technological developments and to share their ideas. Additionally, this conference will also facilitate the participants to expose and share various novel ideas. The conference aims to bridge the researchers working in academia and other professionals through research presentations and keynote addresses in current technological trends. There will be 8 technical sessions, 26 Invited talks, 40 oral presentations, 180 posters and a total of 246 abstracts be presented by the eminent speakers.

I thank each and every one who has been instrumental in organizing this Conference, from all EC members of the Indian Society of Analytical Science-Delhi Chapter and the Local from Organizing Committee CSIR-IIP, for offering in their heart and soul for the grand success. Personally, I look forward to learning from these 3 days to improve my knowledge about green transitions. I wish the National Conference on Frontiers in Chemical Sciences 2022 a grand success.

**Dr Ravindra Kumar**  
**Convener of IAC-2024 & Secretary ISAS-DC**

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## **MESSAGE FROM ORGANIZING SECRETARY**

It is a matter of great pleasure to welcome all the dignitaries, speakers, participants and exhibitors to this three days International Analytical Conference and Exhibition 3<sup>rd</sup> Indian Analytical Congress (IAC-2024) jointly organized by Indian Society of Analytical Scientists, Delhi Chapter (ISAS-DC) & CSIR-Indian Institute of Petroleum (CSIR-IIP) being held at CSIR-IIP Dehradun during 5-7<sup>th</sup> June 2024.

CSIR-IIP shares a strong collaborative relationship with the ISAS-DC and this is the third successful event in succession since 2018. There is a quote from Peter Drucker “If You Can't Measure It, You Can't Improve It”. The meticulous analysis and precise measurements enables problem-solving capability to the researchers. It is also important for industrial growths as it empowers quality assurance and products improvements. So, analytical science is extremely important not only for fundamental research but also for the applied research and technology development. This is also inevitable for crucial innovations and revealing insights in to the research problems of almost all fields. Along with this, the theme “Role of Science & Technology in Green Transitions” in third version of IAC is very relevant to the present scenario. Science and technology play a pivotal role in green transitions by developing sustainable solutions and renewable energy sources, reducing carbon emissions, and mitigating climate change effects. Innovations such as clean energy technologies, efficient transportation systems, and eco-friendly materials drive the transition towards a more environmentally conscious and resilient future.

On behalf of local organizing committee of the IAC-2024 and on my personal behalf, I once again extend a warm welcome to all. I hope that we all will be benefitted by the deliberations, insightful discussions and interactions. I believe that 3<sup>rd</sup> Indian Analytical Congress-2024 platform will provide excellent networking opportunities and will prove to be a successful and memorable event. Thank you for being part of this congress.

**Dr. Raj K. Singh**  
**Organizing Secretary IAC-2024 &**  
**Principal Scientist, CSIR-IIP**



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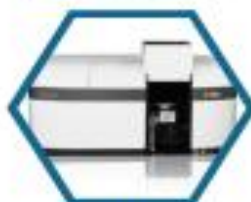
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### Programme

#### Day-1 (5<sup>th</sup> June 2024) Wednesday

|                 |                                                                                                                                                                                                                                                                                                                                                  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0800 – 1600 hrs | <b>REGISTRATION</b>                                                                                                                                                                                                                                                                                                                              |
| 0930 – 1100 hrs | <b>Inaugural Session (Venue: Dr. Lovraj Kumar Auditorium)</b><br><br><b>Chief Guest – Prof. S.K. Mehta</b> , Vice Chancellor, University of Ladakh<br><br><b>Plenary Lecture by Prof Rajnish Kumar</b> , Department of Chemical Engineering, IIT Madras<br><i>CO2 capture &amp; sequestration and it's relevance in net zero target of India</i> |
| 1100 – 1130 hrs | <b>Tea Break</b>                                                                                                                                                                                                                                                                                                                                 |
| 1130 – 1300 hrs | <b>Keynote Session-1: 1130-1300 hrs</b><br><b>(Venue: Dr. Lovraj Kumar Auditorium)</b><br><b>Chairperson:</b> Mr N. Chandrasekhar, Executive Director (R&D), BPCL                                                                                                                                                                                |
|                 | <b>Keynote – 1</b><br><b>Prof. Rengaraj Selvaraj</b> , Dept of Chemistry, Sultan Qaboos University, Muskat, Oman<br><i>Design and fabrication of 2D nanostructured materials for the effective separation of oil from water and wastewater</i>                                                                                                   |
|                 | <b>Keynote – 2</b><br><b>Prof G S Sodhi</b> , Delhi University<br><i>The Importance of Crime Scene Management</i>                                                                                                                                                                                                                                |
|                 | <b>Keynote – 3</b><br><b>Dr Mohan Prasad</b> , Sun Pharma, Gurgaon<br><i>A Glimpse into Green Chemistry Practices in Pharmaceutical Industry</i>                                                                                                                                                                                                 |
| 1300 – 1400 hrs | <b>Lunch Break</b>                                                                                                                                                                                                                                                                                                                               |
|                 | <b>THEME SESSION: Energy &amp; Energy Devices (1400 - 1600 hrs)</b><br><b>(Venue: Dr. Lovraj Kumar Auditorium)</b><br><b>Chairperson:</b> Prof. M.S Alam, Jamia Hamdard, Delhi                                                                                                                                                                   |
| 1400 – 1425 hrs | <b>Keynote – 4</b><br><b>Shri. S.K. Bose</b> , Hydrocarbon Sector Skill Council, Govt of India<br><i>Preparing the Workforce for a Sustainable Future: Skills and Strategies for Green Transition</i>                                                                                                                                            |
| 1425 – 1450 hrs | <b>Keynote – 5</b><br><b>Mr. Mahendra Patel</b> , XOS Inc<br><i>Silicon and total Phosphorus measurements in bio-fuels - unprecedented precision and accuracy powered by MWDXRF® technology</i>                                                                                                                                                  |
| 1450 – 1515 hrs | <b>Keynote- 6</b><br><b>Dr Gaurav Pandey</b> , UPES, Dehradun<br><i>Unlocking Energy Horizons: Cutting-Edge Gas Hydrate Technologies for a Sustainable Future</i>                                                                                                                                                                                |
| 1515 – 1530 hrs | <b>ORAL-16</b><br><b>Mr Sunil Kumar</b> , ThermoFisher Scientific<br><i>New insights into Lithium Ion Battery Degradation using Orbitrap High-Resolution Accurate Mass (HRAM)</i>                                                                                                                                                                |
| 1530 – 1545 hrs | <b>ORAL - 40</b><br><b>Tapán Bera</b> , Indian Oil R&D, Faridabad<br><i>Hydrogen mobility in India and IndianOil's initiatives to support Hydrogen ecosystem</i>                                                                                                                                                                                 |

|                 |                                                                                                                                                                                                                  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1545 – 1600 hrs | Q/A                                                                                                                                                                                                              |
| 1600 - 1615 hrs | Tea Break                                                                                                                                                                                                        |
|                 | <b>Keynote Session- 2: 1615 – 1815 hrs</b><br><b>(Venue: Dr. Lovraj Kumar Auditorium)</b><br><b>Chairperson:</b> Prof. Krishan Kant, Ballabgarh College, Faridabad                                               |
| 1615 – 1640 hrs | <b>Keynote- 7</b><br><b>Mr Arghya Maitra</b> , UOP, A Honeywell Company<br><i>Sustainable Technology &amp; Analytical technique to enable Green transition</i>                                                   |
| 1640 – 1705 hrs | <b>Keynote – 8</b><br><b>Dr Bharat Newalkar</b> , BPCL (R&D), Noida<br><i>Net Zero Initiatives by BPCL</i>                                                                                                       |
| 1705- 1730 hrs  | <b>Keynote – 9</b><br><b>Dr. Ajay Tyagi</b> , TTW Health Managing Professionals LLP, Ghaziabad, UP<br><i>Cold, Dry and Green Fluorination of Graphite in making Dry Lubricant for Nuclear and Space Industry</i> |
| 1730 – 1745 hrs | Q/A                                                                                                                                                                                                              |
| End of Day-1    |                                                                                                                                                                                                                  |

## Day-2 (6<sup>th</sup> June 2024) Thursday

|                               |                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0830 1200 hrs                 | REGISTRATION                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                |
|                               | Technical Session –1: 0930 – 1115 hrs                                                                                                                                            |                                                                                                                                                                                                                                                                                                |
|                               | <b>Venue: Dr. Lovraj Kumar Auditorium</b><br><b>Chairperson: Dr. G.D. Thakre</b> , CSIR, IIP                                                                                     | <b>Venue: CV Raman Hall (GF)</b><br><b>Chairperson: Dr Vinod Kumar</b> , J. C. Bose University of Science & Technology, Faridabad                                                                                                                                                              |
| 7 Papers – Each of 12 minutes | <b>ORAL SESSION-1</b><br>ORAL-1<br>ORAL-2<br>ORAL- 3<br>ORAL-4<br>ORAL-5<br>ORAL-6<br>ORAL-7<br>ORAL -8                                                                          | <b>ORAL SESSION-2</b><br>ORAL -9<br>ORAL-10<br>ORAL-11<br>ORAL-12<br>ORAL-13<br>ORAL-14<br>ORAL-19<br>ORAL -20                                                                                                                                                                                 |
| 1115 -1130 hrs                | Tea Break                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                |
|                               | Technical Session – 2: 1130 - 1300 hrs                                                                                                                                           |                                                                                                                                                                                                                                                                                                |
|                               | <b>Venue: Dr. Lovraj Kumar Auditorium</b><br><b>Chairperson: Dr Sudip Ganguly</b> , CSIR-IIP                                                                                     | <b>Venue: CV Raman Hall (GF)</b><br><b>Chairperson: Dr Sanat Kumar</b> , CSIR-IIP                                                                                                                                                                                                              |
| 1130 - 1155 hrs               | <b>Invited Talk –1</b><br><b>Dr TV Rao, IICT</b><br><i>Mixed metal oxide catalysed selective oxidation of organic molecules with green oxidant (O<sub>2</sub>)</i>               | <b>Invited Talk – 4</b><br><b>Prof. Jhuma Ganguly</b> , IEST, Shibpur<br><i>Recent trends of sugar coupled organic carriers for Green Transition</i>                                                                                                                                           |
| 1155 – 1220 hrs               | <b>Invited Talk -2</b><br><b>Prof. S K Shukla</b> , Delhi University<br><i>Chemically responsive and electrically conducting bio polymer nano composite for sensing sciences</i> | <b>Invited Talk – 5</b><br><b>Dr Arun Kumar</b> , Doon University, Dehradun<br><i>Surface Modification of Graphene Oxide with a stabilizing organic molecule having P and N sites: immobilization of economical nanosized CuO: An efficient, robust and reusable catalyst for C–O coupling</i> |

|                                               |                                                                                                                                                                                  |                                                                                                                                                                                                                             |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1220 – 1245 hrs                               | <b>Invited Talk -3</b><br><b>Prof. Ganga Ram Chaudhary</b> , Panjab University, Chandigarh<br><i>Sustainable technologies for wastewater treatment</i>                           | <b>Invited Talk – 6</b><br><b>Dr. Shailey Singhal</b> , UPES, Dehradun<br><i>Textile waste: An increasing menace to the earth</i>                                                                                           |
| 1245 – 1300 hrs                               | <b>Q/A</b>                                                                                                                                                                       | <b>Q/A</b>                                                                                                                                                                                                                  |
| 1300 – 1400 hrs                               | <b>Lunch Break</b>                                                                                                                                                               |                                                                                                                                                                                                                             |
| <b>Technical Session – 3: 1400 - 1545 hrs</b> |                                                                                                                                                                                  |                                                                                                                                                                                                                             |
|                                               | <b>Venue: Dr. Lovraj Kumar Auditorium</b><br><b>Chairperson:</b> Dr. N. Viswanadham, CSIR, IIP                                                                                   | <b>Venue: CV Raman Hall (GF)</b><br><b>Chairperson:</b> Dr Neeraj Atray, CSIR-IIP                                                                                                                                           |
| 1400- 1425 hrs                                | <b>Invited Talk -7</b><br><b>Prof. Vimal Chandra Srivastava</b> , IIT Roorkee,<br><i>Analytical Exploration of Organic Pollutants in Aqueous Solution Using Machine Learning</i> | <b>Invited Talk – 10</b><br><b>Prof. Surender K. Kaushik</b> , Ch Bansi Lal University, Bhiwani<br><i>Biomass based composites for wastewater remediation: A greener and ecofriendly approach for sustainable solutions</i> |
| 1425 – 1450 hrs                               | <b>Invited Talk -8</b><br><b>Dr. Achlesh Daverey</b> , Doon University<br><i>Sophorolipids: Production and Environmental Applications</i>                                        | <b>Invited Talk – 11</b><br><b>Dr. Daisy Joseph</b> , BARC<br><i>Trace elements in the environment –probes such as photons, protons and Synchrotrons</i>                                                                    |
| 1450 - 1515 hrs                               | <b>Invited Talk - 9</b><br><b>Dr. N. Sathish</b> , CSIR-AMPRI<br><i>Design and development of Make in India Raman Spectrometers at CSIR-AMPRI</i>                                | <b>Invited Talk – 12</b><br><b>Dr Hemant Tyagi</b> , HMEL<br><i>Estimation of Naphthalenes in coloured samples by GC-MS</i>                                                                                                 |
| 1515 – 1530 hrs                               | <b>ORAL-15</b><br><b>Mr Sunil Iyer</b> , Skytech<br><i>Nitrogen Interference in UVF Sulphur Analysis – Effects &amp; Way Forward</i>                                             | <b>Oral – 30</b><br><b>Mr. Vipul Sharma</b> , Indian Oil Corporation<br><i>Procurement Challenges &amp; Solutions for Government Research Organizations</i>                                                                 |
| 1530 – 1545 hrs                               | <b>Q/A</b>                                                                                                                                                                       | <b>Q/A</b>                                                                                                                                                                                                                  |
| 1545 – 1800 hrs                               | <ul style="list-style-type: none"><li>• <b>Poster Session-1</b></li><li>• <b>Networking Tea</b></li></ul>                                                                        |                                                                                                                                                                                                                             |
| 1900 hrs                                      | <b>CULTURAL PROGRAM FOLLOWED BY DINNER</b>                                                                                                                                       |                                                                                                                                                                                                                             |

### Day-3 (7<sup>th</sup> June 2024) Friday

| <b>Technical Session- 4: 0930 – 1130 hrs</b> |                                                                                                                            |                                                                                                                                   |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
|                                              | <b>Venue: Dr. Lovraj Kumar Auditorium</b><br><b>Chairperson: Dr Gita Rani</b> , CDLU, Haryana                              | <b>Venue: CV Raman Hall (GF)</b><br><b>Chairperson: Dr. Suman L. Jain</b> , CSIR, IIP                                             |
| <b>7 Papers – Each of 12 minutes</b>         | <b>ORAL SESSION-3</b><br>ORAL- 21<br>ORAL- 22<br>ORAL-23<br>ORAL-24<br>ORAL-25<br>ORAL-26<br>ORAL-27<br>ORAL-28<br>ORAL-29 | <b>ORAL SESSION- 4</b><br>ORAL- 31<br>ORAL- 32<br>ORAL- 33<br>ORAL- 34<br>ORAL -35<br>ORAL- 36<br>ORAL -37<br>ORAL -38<br>ORAL-39 |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1130 – 1300 hrs | <ul style="list-style-type: none"> <li>• <b>Poster Session-2</b></li> <li>• <b>Networking Tea</b></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                |
| 1300 – 1400 hrs | <b>Lunch Break</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                |
|                 | <b>Technical Session: 5 (1400 - 1545 hrs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                |
|                 | <b>Venue: Dr. Lovraj Kumar Auditorium)</b><br><b>Chairperson: Prof Ashok Kumar Sharma,</b><br>DCRUST, Murthal, Haryana                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Venue: CV Raman Hall (GF)</b><br><b>Chairperson: Dr. A.V. Karthikeyani,</b> IndianOil R&D                                                                                                                                                                                   |
| 1400 - 1425 hrs | <b>Invited – 13</b><br><b>Dr Rohit K Sharma,</b> Panjab University, Chandigarh<br><i>Peptide based Nanoconjugates as New Age Green Scaffolds for Cell Internalization, Bio-sensing and Self-Assembled Bio-inspired Materials</i>                                                                                                                                                                                                                                                                                                                            | <b>Invited- 16</b><br><b>Dr Vineet Kumar,</b> FRI, Dehradun<br><i>Bioinspiration and Biomimicry for Bioresource Utilization</i>                                                                                                                                                |
| 1425 – 1450 hrs | <b>Invited – 14</b><br><b>Prof. Harish Kumar,</b> CUH, Mahendergarh<br><i>Nanocomposites-based electrochemical food sensors for the detection of different food additives</i>                                                                                                                                                                                                                                                                                                                                                                               | <b>Invited - 17</b><br><b>Mr Manoj Bansal,</b> ThermoFisher Scientific<br><i>Twin-Screw Compounding for Filament Production</i>                                                                                                                                                |
| 1450 – 1515 hrs | <b>Invited – 15</b><br><b>Mr. Rahul Bhardwaj,</b> JEOL India<br><i>Transmission Electron Microscope as a Tool for the Characterization in Petrochemical Industry</i>                                                                                                                                                                                                                                                                                                                                                                                        | <b>ORAL-17</b><br><b>Mr. Naveen Singh,</b> Petroleum Analyzer Company (PAC), Marsap<br><i>Analytical Solutions for Renewable Fuels</i><br><br><b>ORAL-18</b><br><b>Dr. Dipanjan Giri,</b> AIMIL<br><i>Role of Gel Permeation Chromatography in advancing polymer recycling</i> |
| 1515 – 1530 hrs | <b>Q/A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                |
| 1545 – 1700 hrs | <b>Valedictory Session (Venue: Dr. Lovraj Kumar Auditorium)</b><br><br><b>Guest of Honour– Mr Alok Sharma,</b> Director (R&D), Indian Oil Corporation<br><br><b>Chief Guest: Mr Amit Sharma,</b> Secretary, Rural Development, It, Transport, S&T, DMRRR, The Administration of UT of Ladakh<br><br><ul style="list-style-type: none"> <li>• <b>Best Poster Awards (10 Number)</b></li> <li>• <b>Best Exhibitor Awards</b></li> <li>• <b>Valedictory Address by the Guest of Honour</b></li> <li>• <b>Valedictory Address by the Chief Guest</b></li> </ul> |                                                                                                                                                                                                                                                                                |
| 1700 hrs        | <b>HIGH TEA AND END OF CONFERENCE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                |



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**KEYNOTE ADDRESS**

| IAC Number | Title                                                                                                                       | Author            |
|------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------|
| KN-1       | Design and Fabrication of 2D Nanostructured Materials for the Effective Separation of Oil from Water and Wastewater         | Rengaraj Selvaraj |
| KN-2       | The Importance of Crime Scene Management                                                                                    | G S Sodhi         |
| KN-3       | A Glimpse into Green Chemistry Practices in Pharmaceutical Industry                                                         | Mohan Prasad      |
| KN-4       | Preparing the Workforce for a Sustainable Future: Skills and Strategies for Green Transition                                | S.K. Bose         |
| KN-5       | Silicon and Total Phosphorus Measurements in Bio-Fuels - Unprecedented Precision and Accuracy Powered By MWDXRF® Technology | Mahendra Patel    |
| KN-6       | Unlocking Energy Horizons: Cutting-Edge Gas Hydrate Technologies for a Sustainable Future                                   | Gaurav Pandey     |
| KN-7       | Sustainable Technology & Analytical technique to enable Green transition                                                    | Arghya Maitra     |
| KN-8       | Net Zero Initiatives By BPCL                                                                                                | Bharat Newalkar   |
| KN-9       | Cold, Dry and Green Fluorination of Graphite in Making Dry Lubricant for Nuclear and Space Industry                         | Ajay Tyagi        |

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**June 5-7, 2024**

**INVITED TALK**

| IAC Number | Title                                                                                                                                                                                                    | Author                   |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| IT-1       | Mixed Metal Oxide Catalysed Selective Oxidation of Organic Molecules with Green Oxidant (O <sub>2</sub> )                                                                                                | TV Rao                   |
| IT-2       | Chemically Responsive and Electrically Conducting Bio Polymer Nano Composite for Sensing Sciences                                                                                                        | S K Shukla               |
| IT-3       | Sustainable Technologies for Wastewater Treatment                                                                                                                                                        | Ganga Ram Chaudhary      |
| IT-4       | Recent Trends of Sugar Coupled Organic Carriers for Green Transition                                                                                                                                     | Jhuma Ganguly            |
| IT-5       | Surface Modification of Graphene Oxide with a Stabilizing Organic Molecule having P And N Sites: Immobilization of Economical Nanosized CuO: An Efficient, Robust and Reusable Catalyst for C-O Coupling | Arun Kumar               |
| IT-6       | Textile Waste: An Increasing Menace to The Earth                                                                                                                                                         | Shailey Singhal          |
| IT-7       | Analytical Exploration of Organic Pollutants In Aqueous Solution Using Machine Learning                                                                                                                  | Vimal Chandra Srivastava |
| IT-8       | Sophorolipids: Production and Environmental Applications                                                                                                                                                 | Achlesh Daverey          |
| IT-9       | Design And Development of Make in India Raman Spectrometers at CSIR-AMPRI                                                                                                                                | N. Sathish               |
| IT-10      | Biomass Based Composites for Wastewater Remediation: A Greener and Ecofriendly Approach for Sustainable Solutions                                                                                        | Surender K. Kaushik      |
| IT-11      | Trace Elements in The Environment –Probes Such as Photons, Protons and Synchrotrons                                                                                                                      | Daisy Joseph             |
| IT-12      | Estimation of Naphthalenes in Coloured Samples By GC-MS                                                                                                                                                  | Hemant Tyagi             |
| IT-13      | Peptide Based Nanoconjugates As New Age Green Scaffolds for Cell Internalization, Bio-Sensing and Self-Assembled Bio-Inspired Materials                                                                  | Rohit K Sharma           |

|       |                                                                                                 |                |
|-------|-------------------------------------------------------------------------------------------------|----------------|
| IT-14 | Nanocomposites-Based Electrochemical Food Sensors for the Detection of Different Food Additives | Harish Kumar   |
| IT-15 | Transmission Electron Microscope as a Tool for the Characterization in Petrochemical Industry   | Rahul Bhardwaj |
| IT-16 | Bioinspiration and Biomimicry for Bioresource Utilization                                       | Vineet Kumar   |
| IT-17 | Twin-Screw Compounding for Filament Production                                                  | Manoj Bansal   |



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**June 5-7, 2024**

## **CONTRIBUTORY PAPERS**

| IAC Number | Title                                                                                                                                                                                                                        | Presenting Author    |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| IAC-24-01  | Synthesis And Application of Zinc-Loaded CMTKG-Based Superabsorbent Hydrogels to Investigate the Effect on Sesame Plant Growth                                                                                               | Arpit Sand           |
| IAC-24-02  | Advanced Functional Nanomaterials for Biomedical Applications                                                                                                                                                                | Sumit Kumar Pramanik |
| IAC-24-03  | Prevention of Accidents in Laboratory                                                                                                                                                                                        | Manoj Popli          |
| IAC-24-04  | Desulfurization of Fuels via Ternary Deep Eutectic Solvents                                                                                                                                                                  | Nisha                |
| IAC-24-05  | Delving into Obesity's Molecular Riddles: Examining resveratrol's Intervention in TLR4/MyD88/NF-κB/iNOS Signaling for Vascular and Cardiac Health                                                                            | Srishti Srivastav    |
| IAC-24-06  | Advanced Study on Smart Nanomaterial Based Sensors for the Detection of Toxic Analytes in Water Produced from Petroleum Industry                                                                                             | Hazvinei Maglanda    |
| IAC-24-07  | Study of Cavitation Treatment in E20 Gasoline by Advanced <sup>1</sup> H PFGSE-Diffusion NMR                                                                                                                                 | Dr Sujit Mondal      |
| IAC-24-08  | Demonstration of Plastic Degrading Efficacies of Coleopteran and Lepidopteron Insects                                                                                                                                        | Sakshi Singh         |
| IAC-24-09  | Adsorption Approaches for Cleaner Kitchen Wastewater: Challenges and Opportunities for Creative Use of The UV-Vis Spectrophotometer                                                                                          | Alka Harit           |
| IAC-24-10  | UPLC-Q-TOF-MS/MS and HPLC-ELSD Based Chemometric Approaches for Marker Compound Identification in <i>Trillium govanianum</i> Wall. Ex D. Don (Nag Chhatri): Inference for Medicinal Properties and Genetic Stock Improvement | Surendra Singh Bisht |
| IAC-24-11  | Synthesis and Evaluation of Poly(acrylate-co-benzyl maleate) Copolymers as Wax Deposition Inhibitors for Crude Oil                                                                                                           | Kapil Bhati          |

|                  |                                                                                                                                                                    |                      |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>IAC-24-12</b> | Preparation of Zeolite ZSM-5 from Coal Waste Material (CWM) and its Application in Methane Dehydroaromatization                                                    | Anil Chandra Kothari |
| <b>IAC-24-13</b> | Improving the Oxidation Stability of UCO-Biodiesel using Metal Deactivators                                                                                        | Shoaib Akhtar        |
| <b>IAC-24-14</b> | Biodegradable Flexible Electronics: A Comprehensive Study on Graphene Reinforced Natural Polymer composites                                                        | Saurav Kumar Maity   |
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| <b>IAC-24-174</b> | Self-powered, wide spectral UV response out-of-plane photodetector based on ZnO/porous Silicon heterostructure                                              | Bhanu Prakash Bisht   |
| <b>IAC-24-175</b> | Non-trivial band topology in Metalloids AuSn 4 , PdSn 4 and Pb 2 Pd: A first principle study                                                                | Navneet Kumar Karn    |
| <b>IAC-24-176</b> | Nanoparticle Mediated Shoot and Root Elongation In <i>Boerhavia Diffusa</i> : Unveiling Growth Potential During in Vitro Cultivation                        | Kavita Gahtori        |
| <b>IAC-24-177</b> | Laser molecular beam epitaxy of vertically self-aligned GaN nanorod array on flexible metal foil and their applications                                     | Bipul Kumar Pradhan   |
| <b>IAC-24-178</b> | Antimicrobial and Antioxidant Activity of Herbal Based Mosquito Repellent Essential oils                                                                    | Ajay Kumar Ahirwar    |
| <b>IAC-24-179</b> | Geothermal Favourability Investigations along the Central Indian Tectonic Zone Using Multi-Categorical Data Analysis (MCDA)                                 | Soubhik Mondal        |

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| <b>IAC-24-184</b> | Formulation and Evaluation of Alpinia galanga phospholipid complex                                                                                                                                    | Ittishree            |
| <b>IAC-24-189</b> | Exploring recent approaches using nanostructures for efficient and facile synthesis of biologically important Bis(indolyl)methanes (BIM).                                                             | Ritu Mathur          |
| <b>IAC-24-190</b> | Synthesis, characterization of novel pyrazole derived Schiff based and their 3d-metal complexes: Anticancer cell line, BSA binding and DFT study                                                      | Prateek Tyagi        |
| <b>IAC-24-195</b> | Toughened epoxy based nanocomposites materials for EMI shielding                                                                                                                                      | Ravi Kant            |
| <b>IAC-24-196</b> | Synthesis and characterization of carboxylic acid crosslinked polyvinyl alcohol films                                                                                                                 | Leela Gautam         |
| <b>IAC-24-197</b> | Nanofibers Based Smart Scaffolds for Tissue Regeneration                                                                                                                                              | Yashpal Sharma       |
| <b>IAC-24-198</b> | A Coumarin-Based Optical Probe for the Quantitative Determination of Fe <sup>3+</sup> ions in Water, Petroleum Crude Oil, Catalyst and Natural Samples; An Experimental and Theoretical Investigation | Achala               |
| <b>IAC-24-199</b> | Chemical Composition of Essential Oils of Plumeria Alba Pods                                                                                                                                          | Brijesh Kumari       |
| <b>IAC-24-200</b> | Validated Direct Chiral Separation of Ketorolac and Amlodipine from Pharmaceutical Formulations and in Human Plasma Using Polysaccharide-based Chiral Stationary Phases                               | Manohar Lal          |
| <b>IAC-24-201</b> | Transparent Ceramics: The Material of Next Generation                                                                                                                                                 | Sanjeev Kumar Mishra |
| <b>IAC-24-202</b> | A Quinazolinone Based Optical Probe for the Simultaneous Determination of Fe <sup>3+</sup> and Cu <sup>2+</sup> Content in Aqueous Samples; An Experimental and Theoretical Investigations            | Ashita Raturi        |
| <b>IAC-24-204</b> | Modelling and Simulation of a Canister for Hydrogen Storage                                                                                                                                           | Sanjeev Kumar        |
| <b>IAC-24-205</b> | Comparative Study of Preclinical Data On Toxicological Effects Of Monosodium Glutamate In Animals                                                                                                     | Aashish Kumar Sagar  |
| <b>IAC-24-214</b> | Instrumental techniques used in the utilisation of Pueraria montana weed as lignocellulosic fiber                                                                                                     | Aparna               |
| <b>IAC-24-216</b> | Synthesis and characterization of crosslinked guar galactomannan using malic acid                                                                                                                     | Preeti Chauhan       |
| <b>IAC-24-217</b> | Crosslinking of guar galactomannan with green and economical crosslinker citric acid                                                                                                                  | Achala Singh         |
| <b>IAC-24-220</b> | Role of Gel Permeation Chromatography in advancing polymer recycling                                                                                                                                  | Dipanjan Giri        |

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| <b>IAC-24-222</b> | Procurement Challenges & Solutions for Government Research Organizations                                                                              | Vipul Sharma             |
| <b>IAC-24-223</b> | CO <sub>2</sub> Photoreduction integrated with oxidative coupling of amines over WO <sub>3</sub> /Cu(BTC) nanocomposite                               | Anil Malik               |
| <b>IAC-24-224</b> | Gc-MS/Gc-Fid Based Compositional Analysis of Essential Oil From Thymus Serpyllum L                                                                    | Sushil Bhattarai         |
| <b>IAC-24-225</b> | Exploring the Potential of Renewable Biomass for Engineering Applications                                                                             | Suheel Kumar Porwal      |
| <b>IAC-24-226</b> | MOFs-Derived MWCNTs for Hydrogen storage: Synthesis and characterization                                                                              | Amardeep Singh           |
| <b>IAC-24-227</b> | Second generation ethanol production via improved SSCF using rice straw at low                                                                        | Ajay Sharma              |
| <b>IAC-24-228</b> | Micropores in Hollow Organic Cage Nanocapsule as a Size Exclusion Gate: Cage Entrapped Pd(II)-Catalyst for Efficient Cross-Coupling Reaction          | Rupa Bargakshatriya      |
| <b>IAC-24-229</b> | Hydrogen mobility in India                                                                                                                            | Tapan Bera               |
| <b>IAC-24-230</b> | Design and Application of Air Purifier Tower for indoor and outdoor areas                                                                             | Atul Pratap Singh        |
| <b>IAC-24-231</b> | Crosslinking of galactomannan with green plasticizer malonic acid using green chemistry for biomedical applications                                   | Jyoti Rajput             |
| <b>IAC-24-245</b> | The synthesis of 4-(4-fluorophenyl)-1,2,3-selenadiazole and its experimental investigation of corrosion-inhibition properties on mild steel in 1M HCl | Ravi Kumar               |
| <b>IAC-24-246</b> | Petunia Surfinia extract as Green inhibitors for mild steel corrosion in acidic environment                                                           | Ashish Sihmar            |
| <b>IAC-24-252</b> | Assessment of Microplastic Contamination in Surface and Groundwater of the Himalayan Region in Uttarakhand                                            | Kanchan Deoli Bahukhandi |



## MAGNUS Enterprise

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| Service Capabilities - Multi brand Equipment              | Pipettes and Centrifuge, Deep freezer, Furnace, Bio safety cabinet, Clean Room, Cold room, Incubator, Co2 Incubator, Vacuum Pump, Electronics Balances etc                     |
| Calibration Capabilities for Non NABL & NABL certificates | Pipettes and Centrifuge, Deep freezer, Furnace, Bio safety cabinet, Clean Room, Cold room, Incubator, Co2 Incubator, Electronics Balance all International / Indian Brands etc |
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| Bio Safety Cabinets                                             | Indian                                       |
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| pH meter and testing instruments                                | Ohaus - USA                                  |

**17, Oberoi Building IIInd Floor, plot No. 467, 483, G.T. Road Shahdara, opp. Dilshad Garden Metro Station Delhi 110095.**

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Keynote Address: KN-1

## **Design And Fabrication of 2D Nanostructured Materials for the Effective Separation of Oil from Water and Wastewater**

*Rengaraj Selvaraj*

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### **Abstract:**

The separation of oil from water and wastewater, which includes immiscible oil/water and emulsified oil/water mixtures, is a worldwide challenge because of the large amount of oily wastewater produced in many industrial processes and daily life. For the separation of oil and water, filtration technique is considered the most efficient method because of its high separation efficiency and relatively simple operational process. One of the most common methods used for the treatment of oily contaminated water is the filtration method by modified surfaces. In our laboratory, we have developed g-C<sub>3</sub>N<sub>4</sub> via thermal condensation method. These materials were characterized by using various advanced chemical and structural techniques including XRD, XPS, UV-DRS, FTIR, SEM, and EDX. In order to separate oil from water, stainless-steel meshes were modified and coated with the prepared g-C<sub>3</sub>N<sub>4</sub> Nano sheets to be used for the separation of oil and water mixture. The nanomaterials coated mesh were functionalized with hydrophobic agents. Different tests were performed to investigate the nature of the coated meshes and their stability and efficiency. After many separation tests, it was found that the most efficient coating among all the modified meshes was g-C<sub>3</sub>N<sub>4</sub>, which was functionalized using HDTMS. The separation efficiency of this coated mesh reached nearly 75% and it resulted to fast separation, which happened in a few seconds. In addition, the modified mesh can be used for many cycles and still gives good separation efficiency. These results suggest that the 2D nanostructured coated meshes will be the promising method for the oil spill problem and it will help to remove the oil from the oily contaminated water [1]. Also, our research group applied these materials for the effective removal and degradation of pharmaceuticals, VOC's, EDC's and other contaminants present in water and wastewater [2-4].

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Keynote Address: KN-2

## **The Importance of crime Scene Management**

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### **Abstract:**

The Universal Declaration of Human Rights directs the member nations to create such conditions under which the ideals of free human beings, enjoying civil and political freedom from fear and want, can be achieved. The Constitution of India, through its various articles, strives to ensure security and safety of citizens in accordance with the principles of Universal Declaration of Human Rights. However, crime is a violation of these principles. In a country like India, where a large section of population is uneducated, social set up is heterogeneous, public-police relations are not very cordial, poverty is rampant and unemployment widespread, it is not surprising that crime rate is increasing exponentially. In majority of serious crime cases, hi-tech measures are being adopted by perpetrators. However, the police personnel who visits the scene of may not be holding an academic degree in science and technology. Yet the decisions of the officer bear a strong influence on the eventual outcome of the criminal investigation. It is therefore pertinent that she/he must receive training and guidance to inculcate the spirit of scientific temperament in decision making. This presentation highlights the societal significance of crime scene management.

Keynote Address: KN-3

*Mohan Prasad*

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**Abstract:**

A Glimpse into Green Chemistry Practices in Pharmaceutical Industry Abstract: "Green chemistry" the self-explanatory term is a branch of chemistry that involves the application of chemical product and processes in such a way that reduces the generation of hazardous chemical waste and its release into the environment. It is an intelligent way of doing chemistry in which the waste production is minimized, energy is saved and the depletion of natural resources is cut down to some extent. Significant efforts have been made towards the development of new Green Technologies. It's benefits should reach to the common man. We can synthesize many organic molecules with the help of green chemistry methods. The presentation will cover application of green chemistry in pharmaceuticals with special emphasis on solvents and biocatalysis

Keynote Address: KN-4

## **Preparing the Workforce for a Sustainable Future: Skill and Strategies for Green Transition**

*S. K. Bose*

CEO-HSSC

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### **Abstract:**

India has already announced that it will become net-zero carbon nation by 2070. Presently, startups are exploring and conquering opportunities and are innovating in various sectors from manufacturing, transport, health, agriculture, education, financial services, information technology, data science and sustainability. 54% of the population below the 25 years of age and with over 62% of population in the working age group, India provides an unparalleled opportunity for the world of business and prosperity. India is a hub for skilling and education. The focus is future livelihood, employability, entrepreneurship, education and employment. This provides ample opportunities for Indian youth for skilling, up-skilling and re-skilling and future ready for joining the workforce not only in India but also beyond the boundaries.

The role of startups and MSMEs are critical to chart out a growth path for India.

With India poised for significant growth in the above-mentioned sectors, addressing carbon emission becomes a strategic necessity for sustainable growth besides it's a potential opportunity.

Every country has its roadmap for energy transition and achieving net-zero target. However, India has its own energy transition roadmap for a balanced growth, sustainability through accelerated transitioning into green energy by implementing projects in solar, wind, nuclear, hydel and green hydrogen. As energy demand grows in India, the consumption of fossil fuel would take time to taper down in decades but at the same time the production of green energy would accelerate in coming years.

The huge investment in solar, wind and green hydrogen projects would provide great opportunities for skilling, re-skilling and up-skilling workforce and join green energy related jobs.

Science and technology have always contributed to economic growth by way of innovation and disruption for making the life of people more comfortable.

The skill sectors need to prepare and respond to the need of industry which upgrade their technology very fast to bring in efficiency and higher productivity. The paper aims to discuss the strategy of Hydrocarbon Sector Skill Council to prepare the workforce for future-ready and be a part of growth story of *Viksit Bharat-2047*.

**Keyword** Net-zero, skilling, up-skilling, re-skilling, employability, energy transition, green hydrogen

Keynote Address: KN-5

**Measure Silicon and Total Phosphorus in bio-fuels, gasoline to ethanol and toluene by Signal® and Phoebe® delivers unprecedented precision and accuracy powered by MWDXRF® technology**

*Mahender Patel*

XOS Inc.

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**Abstract:**

Refiners throughout the petroleum and biofuels industry are taking a closer look at the dangers of silicon in gasoline and ethanol. Silicon is a contaminant and, depending on where the contamination occurs along the supply chain, the repercussions can range from engine problems for gasoline end users, to possible poisoning of naphtha hydrotreater catalysts at the refinery level. From gasoline to ethanol and toluene, Signal delivers total silicon analysis followed by ASTM D7757 method. Powered by MWDXRF, Signal is a robust analysis solution for demanding petroleum and industrial environment. This analyzer delivers an LOD as low as 0.65 ppm and does not require conversion gasses, heating elements, quartz tubes or columns.

Total Phosphorus Analysis in Hydrocarbon and Aqueous Matrices From crude oil to bio-fuels, in additives or water, Phoebe® delivers unprecedented precision and accuracy for quantification of phosphorus. Phoebe delivers a LOD of 0.4 ppm in hydrocarbon matrices in a short measurement cycle.

Keynote Address: KN-6

**Unlocking Energy Horizons: Cutting-Edge Gas Hydrate Technologies for a Sustainable Future**

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**Abstract:**

The surge in global greenhouse gas emissions (mainly CO<sub>2</sub>) has introduced the world to the significant problem of climate change. A paradigm shift towards sustainable energy sources is necessary to meet the sustainable development goals (SDGs). Natural gas hydrates are ice-like crystalline solid compounds formed by (host) water molecules, in which the guest (gas) molecules are trapped inside the water cavities. Generally, these guest molecules are methane, ethane, propane, and carbon dioxide, etc. Natural gas hydrates have achieved considerable significance due to their potential role as a future clean energy resource. To improve the kinetics and gas consumption of hydrates system, various kinetic promoters are used such as sodium dodecyl sulfate (SDS), tetrahydrofuran (THF), etc. A novel approach to hydrate-based CO<sub>2</sub> capture and sequestration has gathered significant attention due to its potential to provide long-term CO<sub>2</sub> sequestration and hydrogen storage using hydrogen hydrate technology. Herein, the methane-carbon dioxide sweeping process (CH<sub>4</sub>-CO<sub>2</sub> replacement) has gained considerable interest as it produces clean energy (natural gas) from natural gas hydrate deposits while sequestering anthropogenic CO<sub>2</sub>. Implementation of CCS involves enormous capital expenditure along with transportation, sequestration, and purification costs making its adaptability economically unfeasible. In this regard, the morphological, kinetics and rheological studies of hydrate systems have gained interest to carried out research for storage and flow assurance applications for a sustainable future.

Keynote Address: KN-7

**Sustainable Technology & Analytical technique to enable Green transition**

*Arghya Maitra*

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**Abstract:**

Honeywell UOP is a leading supplier and licensor of process technologies, catalysts, Adsorbents, equipment and technical services for the refining, petrochemical and Sustainable technologies. In energy sector there is a paradigm shift towards sustainability. Honeywell UOP's Science & technology already have significant footprint on sustainable solution & leading that green transformation. Analytical function & digital labs are two important supportive wings to make those Changes. Honeywell Advanced analytical techniques, lab automations, digitization are among them which uniquely implemented to reduce carbon footprint & supported to develop sustainable technology solution.

Keynote Address: KN-8

**Net Zero Initiatives by BPCL**

*B.L. Newalkar*

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**Abstract:**

The upcoming era of energy transition has thrown open challenges and opportunities to Oil and Gas sector across the world to comply with NET ZERO targets. BPCL is at the forefront of this journey and is targeting to achieve NET ZERO status by 2040. As Indian Oil and Gas industry embark on this journey, the Research and Development (R&D) is going to play a pivotal role to develop India centric cost effective yet cutting edge technologies. This presentation provides BPCL-R&D initiatives to achieve the said objective.

Keynote Address: KN-9

## **Cold, Dry and Green Fluorination of Graphite in making Dry Lubricant for Nuclear and Space Industry**

*Ajay Tyagi*

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### **Abstract:**

Solid dry lubricants are a class of materials which are characterized by low shear strength, high compressibility, high thermal stability and good adhesion. Solid lubricants are thus preferred over liquid lubricants for nuclear industry. Graphite, Molybdenum Disulphide, Tungsten Disulphide, PTFE are good materials to be used as dry lubricant.

Solid lubrication has been widely used in many fields such as aerospace, nuclear industry, oil industry, chemical industry, electric contact and thermal processing of metal or plastic material. Solid lubricants are used where lubricating oils are avoided due to their out gassing under vacuum and high temperature. In such situations solid lubricants play a very important role as they are used as powder or thin film to provide protection from frictional damage during relative movement. Several types of lamellar structure materials, inorganic materials, organic materials and conversion films are used as solid lubricants. A combination of solid and liquid lubrication is also feasible and may have beneficial synergistic effect on the friction and wear performance of sliding surfaces. Solid lubricants can also be dispersed in water, oils and greases to achieve improved friction and wear properties under conditions of extreme pressures and temperatures. Due to lubrication, the coefficient of friction between two rubbing surfaces is reduced, while using solid lubricants such as graphite, molybdenum disulphide, boron nitride and tungsten disulphide.

The cold, dry and green fluorination studies were carried out on the graphite based dry lubricants and chemically modified systems were prepared having improved lubrication properties, where the improvement of lubrication behaviour of fluorinated graphite systems is attributed mainly due to the physio-chemical changes occurring in the lubricant matrix on molecular level.

The experiments were carried out under variable load with graphite in dry condition. The tribometer cell was loaded with powder lubricant so that powder could dynamically enter the frictional clearance between annular top sample and bottom sample during tests. The experimental load was varied from 6 MPa to 18 MPa and speed of the motor was maintained as 0.4 m/s. The powder entry in frictional clearances is confirmed as the values observed for dry friction is higher than with graphite lubricant. The lowering in coefficient of friction with graphite and modified graphite powder is mainly due to the entry of dry lubricant powders into the moving parts of tribometer.

**Wear Loss in graphite and fluorinated graphite dry lubrication systems:**

| <b>S. No.</b> | <b>Sample</b> | <b>Wear Loss on Copper plate (%)</b> |
|---------------|---------------|--------------------------------------|
| 1             | Graphite - 1  | 0.0013                               |
| 2             | Graphite - 2  | 0.0011                               |
| 3             | Graphite - 3  | 0.0003                               |
| 4             | Graphite - 4  | 0.0002                               |
| 5             | Graphite - 5  | 0.0000                               |

The Technology is available to transfer to the industry interested in making the specialized grades of dry lubrication systems first time in the country.

Invited Talk: IT-1

**Mixed metal oxide catalysed selective oxidation of organic molecules with green oxidant (O<sub>2</sub>)**

*T Venkateshwar Rao*

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**Abstract:**

Mixed metal oxides (MMO) play a very important role in academic as well as industrial research due to their acid–base and redox properties and have gained significant attention as catalysts in oxidation reactions due to several advantages they offer. MMO catalysts are oxygen-containing combinations of two or more metallic ions in proportions that may either vary or be defined by a strict stoichiometry. Oxidation is the second largest process after polymerization and contributes 30% of production in the chemical industry. Both selective and total oxidation reactions of organic compounds are important as selective oxidations lead to aldehydes, ketones, carboxylic acids, nitriles which are crucial raw materials for the petrochemical, fine chemicals, polymer, pharmaceuticals industries and total oxidation help in depollution purposes to protect environment. These oxidations reactions were carried out in the beginning using stoichiometric metallic oxidants, halides, organic peroxides, acids, and peracids, etc. which produce significant amounts of toxic waste as by-products. Increasing environmental concerns, and increasing consumption of chemicals force industry to look forward for green and sustainable chemical processes.

In this direction, development of heterogeneous catalytic systems using green oxidant O<sub>2</sub> or air as an oxidant, which is cheap and produces water as the sole by-product, would continue to establish green and sustainable chemical processes. Bulk chemical industries like petroleum and petrochemical industry largely practicing such methods and now even fine chemical and pharma industry also has to switch fast to new oxidation processes that satisfy the principles of green chemistry.

In this work, it is presented about development of various MMO catalysts, characterization of catalysts using various techniques namely XRD, Raman, BET surface area, ICP-OES, FE-SEM, HR-TEM, XPS, and H<sub>2</sub>-TPR and evaluation of various mixed metal oxide catalysts (Ce-Co, Ce-V, Ce-Fe, Ce-Cu, Si/Co etc) selective aerobic oxidation of organic molecules like vnnillyl alcohol, ethyl benzene, cyclohexane, and cyclohexene, etc.

**Chemically responsive and electrically conducting bio polymer nano composite for sensing sciences**

*Saroj Kumar Shukla*

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**Abstract**

Functionalization of polymer generates several novel features like responsiveness, reactivity and interactivity to expand its use in chemical sensors, physical sensor, water remediation, catalyst, agriculture and biomedical applications[1]. The methods adopted to functionalize the polymer includes radiation, composites formation, size confinement, grafting with biopolymers, copolymerization, and doping of different organic and inorganic fillers in optimized surfactants, solvents and physical conditions [2-3]. In the context of above developments, present paper describes the basic of limitation of polymers along with requirement of functionality, used methods for functionalization, and evolved properties. Further, the applications of functional polymers in sensing of pesticides, heavy metal, humidity and pharmaceutical are discussed along with features and potentials [4-6].

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Invited Talk: IT-3

**Sustainable technologies for wastewater treatment**

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**Abstract:**

Global urbanization and industrial development had led to various kinds of pollution. The excessive inlet of contaminants into water is affecting its quality adversely which is not recommended for quality health. Therefore, investigating economical, scalable, efficient, and faster approaches for water treatment is crucial. In this direction, nanostuctures (NSs) due to easy fabrication and tailored properties are emerging technology for water quality management via detecting, monitoring, and removing the targeted water contaminants. This work presents a careful and critical discussion of a decade (2011 to 2022) of advancements based on MO-NSs for eradication (via adsorption, photocatalytic degradation, ultrasound-assisted-catalytic degradation/adsorption, and ultrafiltration), of water pollutants, and water disinfection. Moreover, the challenges associated with focused state-of-the-art technology for water quality management, alternative approaches, and possible future aspects are critically delineated. Finally, this work projects MO-NSs-based futuristic approach as green technologies to deliver clean water to everyone and greatly contributes to the community concerned as per the United Nations Sustainable Development Goal 6. Sustainability is the key success indicator of industries in view of the regulatory guidelines of the Environmental protection Agency. The major implications rely on implementation of the green chemistry tools. In this regard, due attention has been focused on the role of water in promoting chemical reactions using nanocatalysts.

## Recent trends of sugar coupled organic carriers for Green Transition

Jhuma Ganguly

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### Abstract:

Nature has made available a huge resource of Glycomaterials. Functionalized Glycomaterials are explored by researcher as a new process initially due to their (i) available bio-resources ; (ii) as bio-economic-initiative, (iii) insolubility in water as polymeric and hydrogel forms (iv) acceptable chemical compatibility and degradability. A robust challenge for the functionalization of Glycomaterials must have four conditions for future aspects (a) new simple synthetic-strategy (b) eco-friendly (c) societal-acceptance and (d) Recycling. Actually, the modification of Glycomaterials as sustainable products over existing materials could be a better approach to ensure for the regulation of bio-resources, for financial interest and positive drive for the protection and safety of environment and health. Structural-networks of functionalized Glycomaterials and their responses towards functions are very significant to assess their recognitions as new sustainable biomaterials. Structural-networks are crucial for the absorption or encapsulation of guest molecules, e.g. drugs, dyes, metal cations, anions etc. The controlling of chemical bondings within gel-networks directs the binding efficiency of them. The mechanisms of binding efficacy are rationalized using their new physical parameters obtained or their response towards stimuli. Bioorthogonally hydrogels from sugar resources are prepared through rapid reaction strategy or click chemistry could be better sustainable materials in today's scenario.



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Invited Talk: IT-5

**Surface Modification of Graphene Oxide with a stabilizing organic molecule having P and N sites: immobilization of economical nanosized CuO: An efficient, robust and reusable catalyst for C–O coupling reactions**

*Arun Kumar*

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**Abstract:**

A promising graphene oxide (GO) anchored robust and thermally stable heterogeneous catalytic system has been developed. It contains the low-cost copper oxide as catalytic active material for C–O coupling reactions. A hybrid ligand (i.e.  $\text{PPh}_2\text{--CH}_2\text{--CH}_2\text{--NH}_2$ ) has been used for the first time for functionalization of GO surface. This ligand grafted over GO sheets via covalent linkage acts as an efficient stabilizing and chelating agent for CuO nanoparticles through P and N donor sites to form the catalytic system (GO-PN-CuO). The powder X-ray diffraction (PXRD), infra-red (IR), X-ray photoelectron spectroscopy (XPS), thermogravimetric analysis (TGA), Brunauer-Emmett-Teller studies (BET), scanning electron microscopy (SEM-EDX), transmission electron microscopy (TEM) and Raman spectroscopy authenticated the step-wise formation of GO-PN-CuO. The catalytic potential of GO-PN-CuO has been explored for C–O coupling reactions of phenols with several aryl bromides and chlorides under mild reaction conditions. The covalent linkage of hybrid ligand with GO sheets and strong binding abilities of P, N donor sites with CuO, render high stability to GO-PN-CuO. The catalytic system offers the advantage of recyclability up to five reaction cycles without any considerable loss in activity.

Invited Talk: IT-6

**Textile waste: An increasing menace to the earth**

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**Abstract:**

Textile waste: An increasing menace to the earth Shailey Singhal Department of Chemistry, Cluster of Applied Sciences, UPES, Dehradun Sustainability accounts for the overall development and growth of the society in a holistic manner. Utilizing each and every resource available around us including waste with value-addition is crucial for moving towards sustainable development and contribute to the circular economy of the country. There are numerous resources around, which can be valorised to obtain energy and value-added products of industrial significance. The key is to identify the resources and their appropriate administration for converting waste to wealth, keeping environmental preservation in view. Textile waste is creating menace on the earth and contributing to all the forms of environmental pollution including air, water and soil. Certain means of up-cycling this waste are in practice, which although do not seem sufficient to get rid of textile waste completely. Therefore, feasible routes are required to be worked out in order to scientifically manage the textile waste and produce valuable items out of it. This will contribute to the develop a closed loop approach to the textile industry contributing to the circular economy of the country.

Invited Talk: IT-7

### **Analytical Exploration of Organic Pollutants in Aqueous Solution Using Machine Learning**

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#### **Abstract:**

Organic pollutants are chemical compounds originating from living organisms, which are ruining the aquatic environment and public health thoroughly. They are present in aqueous solutions in the form of pharmaceutical and personal care products (PPCPs), pesticides and herbicides, industrial chemicals, polycyclic aromatic hydrocarbons (PAHs), chlorinated compounds, bisphenol A (BPA), etc. Traditional methods are available for the analytical exploration of organic pollutants in aqueous solutions. However, machine learning (ML), an emerging powerful tool, has recently been used for the analytical exploration of organic pollutants in aqueous solutions by many researchers because of its robust design and accurate prediction. Furthermore, machine learning (ML) can potentially classify, detect, and predict the concentration of organic pollutants in aqueous solutions. Here, a case study is conducted for the application of machine learning (ML) for the compelling analytical exploration of organic pollutants in aqueous solution. Overall, this study refers to the potential use of machine learning (ML), explaining its advantages, challenges, and future scope for addressing the global issue of organic pollutant contamination in aqueous environments.

**Keywords:** Machine learning (ML), organic pollutants, aquatic environment.

Invited Talk: IT-8

**Sophorolipids: Production and Environmental Applications**

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**Abstract:**

Sophorolipids (SLs) are glycolipid type of biosurfactants, which are mainly produced by selective yeasts. SLs possess excellent surfactant properties and are biodegradable, which make them superior surface active agents over their chemical counterparts. The production of SLs from renewable substrates such as molasses, cheese whey, waste cooking oil, and wastewater are discussed. The potential of SLs in environmental applications such as phytoremediation of heavy metal contaminated soil, control of algal bloom, biodegradation of polycyclic aromatic hydrocarbons (PAHs), enhanced oil recovery etc., are also discussed.

**Keywords:** Biosurfactant; Bioremediation; Phytoremediation; Algal bloom; Waste valorization

**Design and development of Make in India Raman Spectrometers at CSIR-AMPRI, its applications in analytical characterization: A tool for graphene characterizations**

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**Abstract:**

CSIR has developed and commercialized the Raman spectrometers in a public-private partnership under the CSIR-New Millennium Indian Technology Leadership Initiative (NMITLI) program. The developed Raman spectrometers are validated with NIST: Standard Reference Database 78, Atomic spectra of Neon covering visible range, and ASTM (Raman shift frequency standards (ASTM E 1840) for use in the calibrating of Raman spectrometers) standards and checked for its optical design for maximizing Spectrometer Throughput and Etendue, resolution and reproducibility at par with international standards. The complete system integration, optimization, and data collection software developed in India and powerful post-processing software and database management software are developed with the system, this put the development of about 20-25% value content in Make India development. At present for the commercial Raman spectrometers market, few Indian companies introduced the portable and handheld Raman spectrometers. However, until the present development, there were no Indian manufacturers, making high spectral resolution confocal micro-Raman spectrometers and participating in tenders, which is a very niche market and heavily relies on the import of Raman spectrometers from abroad. The raman spectroscopy is application in various applications, a few studies are presented in detail for Raman spectroscopy and imaging methods for quantitatively and qualitative characterization of Graphene materials (Bulk and CVD graphene) using the developed raman spectrometers. Raman spectroscopy imaging and Wavelet based methods for removal of other components to find the number of layers in graphene materials & Validation using TEM & HRTEM

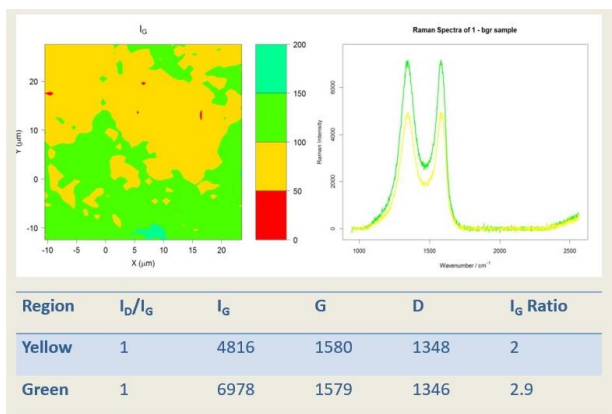


Fig : Raman imaging of bulk graphene G peak and its ratio

Invited Talk: IT-10

**Biomass based composites for wastewater remediation: A greener and ecofriendly approach for sustainable solutions**

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**Abstract:**

The escalating environmental concerns and the urgent need for sustainable solutions have steered the focus towards biomass-based composites for wastewater remediation. However, a lot of processes such as advanced oxidation, electrochemical oxidation, reverse osmosis, coagulation, flocculation, Fenton oxidation, adsorption etc. have been utilized, but adsorption using biomass-based composites have shown promising results due to their high efficiency and low cost. This paper explores the potential of biomass-derived composites as eco-friendly alternatives for remediating wastewater. The bio composites of *Saccharum munja* were prepared and their efficacy was evaluated for removal of dyes and heavy metals. These synthesized bio composites demonstrate a good potential towards pollutant removal. Moreover, the overall impact of the process aligns with circular bioeconomic approach involving the valorisation of waste biomass as an adsorbent, which not only helps to reduce waste but also provides a cost-effective solution for wastewater treatment. Thus, bio composites stand as a potential candidate for wastewater treatment and provides a greener solution.

**Keywords:** adsorption, biomass-based adsorbents, circular bioeconomy, contaminant removal.

**Trace elements in the environment –probes such as photons, protons and Synchrotrons**

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**Abstract:**

Trace metals in the environment due to the effects of effluents in natural environments, such as rainwater clogging, mangroves, insects, marine fishes, and water pollution do exist. Investigations of the problem of toxicity in the Environment needs to be studied. The useful ingredients of trace elements present in naturally occurring plants, herbs, and spices also needs to be studied which includes medicines extracted from herbs, such as Ayurveda medicines and other alternative medicines for bioremediation and phyto-remediation. This work will be a useful source of information for doctors, environmentalists, researchers in biosciences, pharmaceuticals, and pharmacists. The work will enlighten space travellers to relate to atmospheric trace metal levels, considering the ozone layer. Trace metal analysis in the environment will help bring down the toxicity in the environment by introducing environmentally friendly products for easier waste disposal. Waste to wealth should be the motto, and it can provide exact pictures of trace metals levels in all environment-related materials present in the universe. The determination of the trace-elemental composition especially of biological materials especially environment is a difficult and challenging experimental problem. It is necessary to determine small concentrations of many elements in the presence of major concentrations of hydrogen, carbon, and oxygen. The sample is generally heterogeneous on a very small scale. Biological material is generally wet and not readily compatible with a vacuum system, or it may require extensive preparation prior to analysis. Because of these factors there is no universal system available for making elemental determinations in the life sciences. X-ray fluorescence (XRF) for measurement of elemental concentrations in biological materials has been used for many years. XRF uses a source of high-energy X-rays to irradiate a target to produce vacancies in the inner shells of the atoms which comprise the material. When these vacancies are filled, characteristic X-rays are emitted which can be detected and used for qualitative and quantitative analysis of the elemental concentration. Applications of XRF are ultimately related to the type of X-ray source used in the work. The ideal X-ray source will produce the high X-ray flux at the sample which is necessary for the best application of the method. My presentation will elucidate the variations of XRF using photons, protons and synchrotrons' as sources and its varied applications relating to environment.

Invited Talk: IT-12

**Estimation of Naphthalene Content in Coloured Oil Samples by GC Mass Spectroscopy**

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**Abstract:**

Naphthalene is an organic compound with formula  $C_{10}H_8$  and melting temperature  $80^{\circ}C$ . This compound is present in Pyrolysis fuel oil and its feed (PAN oil). Due to the presence of Naphthalene in Pyrolysis fuel oil and its feed (PAN oil), maintaining viscosity of these products or streams remains a challenge. With the estimation of Naphthalene contents in these coloured samples, desired viscosity can maintain. Naphthalene contents can be analysed in oil sample spectrophotometrically by developing a colour and taking absorbance in the visible range as per test method IS 1448: P118 and ASTM D1840. With this technique, there is a limitation to analyse Naphthalene content in coloured samples where further colour development is not consistent due to interference of sample colour. In the present work, a new method has developed for the analysis of Naphthalene Content in coloured oil samples like PAN Oil and Pyrolyzed Fuel Oil by GC Mass Spectroscopy.

## Peptide based Nanoconjugates as New Age Green Scaffolds for Self-Assembly, Cell Internalization and Bio-sensing Materials

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### Abstract:

Biomolecule-nanoconjugate systems provide novel hybrid materials having combination of the unique optical, electronic, or catalytic properties of the nanoparticles with the recognition or biocatalytic functions of biomolecules. Such bioconjugate systems have applications in various fields such as self-assembled materials, bio-sensing, bio- imaging, cell internalization etc. In this regard, we have been exploring our research mainly in two categories: (a) How does a novel biomolecule nanoconjugate system act as a platform for bio-sensing? (b) How is this hybrid system capable for cell internalization?

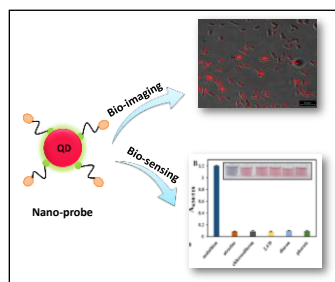


**Fig. 1.** Schematic illustration of multifunctional biomolecule nano-conjugate systems for bio-imaging and bio-sensing

The first step of the finding answers involves research comprising of synthesis and development of biomolecule nanoparticle conjugate systems which would be efficient for bio-sensing as well as for cell internalization. The main challenge in the bio-sensing application is the specificity and selectivity of developed bio-conjugate systems towards specific analytes. In this regard, we have developed different molecular systems comprising of peptides, aptamers and polymers with various metallic nanoparticles (gold and silver) as well as quantum dots. These developed biomolecule-nanoconjugate systems provide an array for specific and selective detection of various analytes such as organophosphorous pesticides, metal ions etc. Further, the newly generated biomolecule conjugated systems have been explored for application in internalization of therapeutic agents into microbial cell membrane. These novel systems can be employed for conjugating various cargo moieties such as oligonucleotides, proteins, RNAs, DNAs, signal molecules, antigens, drug molecules. Subsequently, this approach can be used for the targeting killing of microbial cells using photo-thermal therapy as well as used as a vector to deliver antimicrobial agents or any other type of compounds directly into the cells.

## Nanocomposites-based electrochemical food sensors for the detection of different food additives

Harish Kumar

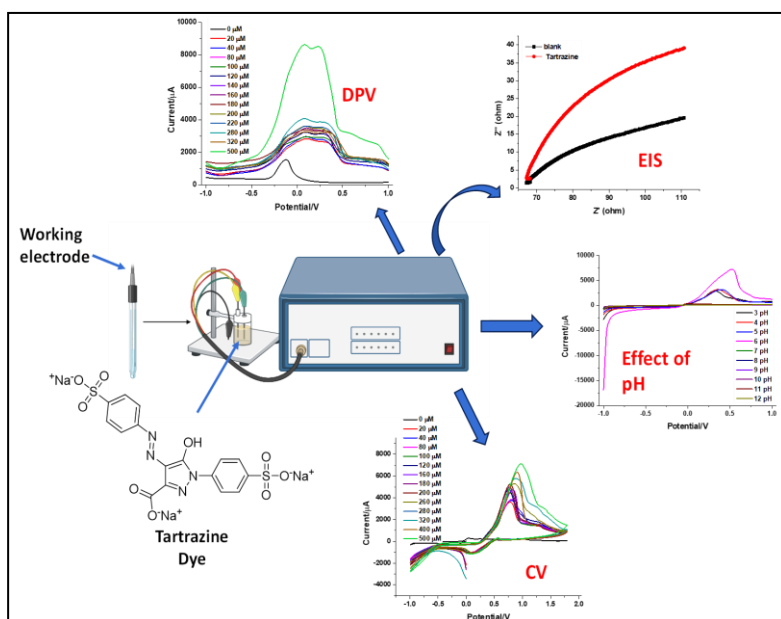
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### Abstract:

Metal nanoparticles and nanocomposites based on conducting polymers, reduced graphene oxide, and metal nanoparticles have potential applications in electrochemical sensors for sensing food additives, environment pollutants, and biological warfare agents. The synthesis of advanced functional nanomaterials is possible with modified Hummers methods, hydrothermal/solvothermal, micromechanical exfoliation, ligand-assisted, small molecule mediated synthesis, ultrasonic exfoliation, chemical vapor deposition methods, etc. The characterization of nanomaterials can be done by TEM/SEM, XRD, FTIR, TGA/DTA, UV-visible, and Raman Spectroscopic techniques. These nanostructured materials can be tailored according to the needs of the industry for sensing different analytes. We have fabricated different electrochemical food sensors for the detection of different food preservatives, additives, and coloring agents. These nanostructured nanomaterials have the potential to revolutionize materials for next-generation applications.

**Keywords:** Electrochemical sensors, food additives, Cyclic voltammetry, Differential pulse voltammetry.



**Bioinspiration and Biomimicry for Bioresource Utilization**

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**Abstract:**

Bioinspiration and Biomimicry explore the chemistry of nature and how one can replicate what nature does in abiological settings. The abundant bioresource available in nature offers innumerable opportunities for addressing the pressing challenges if bioinspiration and biomimicry can be understood in the true sense and applied in the synthesis of different products. However, understanding the mystery of chemical and biological transformations is a challenging task owing to the exceedingly complex and hitherto unknown chemical structures created by biosynthetic route. Recent advancements in diverse analytical techniques including chromatographic and spectroscopic advancements have led to a better understating of a few pathways. This in turn enabled researchers to tap the potential bioresource to a small extent.

In our laboratory, utilization of bioresources has been done through bioinspiration and biomimicry. As a case study, functionalization of galactomannan has been achieved by crosslinking with malonic acid, a green, water-soluble, simple organic dicarboxylic acid with minimum chain length possessing natural plasticizer properties using bioinspiration to introduce 1,3-propane dioates in the galactomannan chains resulting in flexible crosslinked films of galactomannans. Further, curcumin has been loaded in these crosslinked films and kinetic studies demonstrate that curcumin has a non-fickian diffusion controlled release mechanism (DCR). The antibacterial, antifungal and antioxidant studies depict that prepared formulation has potential utility in sustained drug delivery and other biomedical applications. In another study, a novel simple, eco-friendly process has been developed for the isolation of fiber from pine needles. The process does not demand large space, energy, instrumentation, etc. The isolated fibre despite being a non-traditional fiber, is fairly long (~20cm) and shiny and can be spun into coarse, strong threads and is among the cheapest natural fibers. Nevertheless, numerous challenges are there when technology is used in the field. Thus the requirement and constraints in the present circumstances will be discussed in detail.

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Invited Talk: IT-17

## **Twin-Screw Compounding for Filament Production**

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### **Abstract:**

3D printing has emerged as an invaluable tool for creating three-dimensional objects by extruding molten plastic through a small nozzle. Although a variety of materials can be used in the 3D printing process, including concrete, human cells, and metal, polymers are still the most common. The "ink" for these fused deposition 3D printers is polymer filaments with a defined and very constant diameter. To make these filaments from a basic polymer, simple single-screw extruders are used. Single-screw extruders have high pressure build-up and constant output, which ensures a constant filament diameter. However, on the downside, single screw extruders are very inefficient mixers, which limits their usage for filament production to readily available polymers or a multiple-step process.

For advanced polymer compounds or customized product formulations, twin-screw extruders, owing to their high mixing capacity, have to be used. Such twin-screw extruders allow for the compounding of multiple ingredients into a homogeneous blend during the extrusion process. The twin-screw extrusion process results in a slightly pulsating flow output, which makes it difficult to maintain a constant filament diameter. The solution to this challenge is the use of a melt pump located between the end of the extruder and the strand-forming nozzle. The regulated flow of material ensures that the filament is constant in diameter. Using a twin-screw extruder not only ensures the high homogeneity of the material but also ensures a constant diameter of filament.

**Synthesis and Application of Zinc-Loaded CMTKG-Based Superabsorbent Hydrogels to Investigate the Effect on Sesame Plant Growth**

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**Abstract:**

In the present work, an unreported graft copolymerization of Meth acrylic Acid (MAA) onto CMTKG has been synthesized by free radical polymerization in a nitrogen atmosphere using bromate/ thiourea system. Grafting ratio (%G), efficiency (%E), add-on (%A), and conversion (%C) increase upon increasing the concentration of bromate and acrylamide, whereas they decrease upon increasing the concentration of guar gum. Upon increasing the concentration of thiourea and hydrogen ions up to  $3.2 \times 10^{-3} \text{ mol dm}^{-3}$  and  $4.0 \times 10^{-3} \text{ mol dm}^{-3}$ , respectively, the grafting ratio (%G) and efficiency (%E) increase but decrease upon further increasing the concentration. The increase in temperature from 30 to 45°C increases the grafting ratio but the conversion efficiency decreases. The optimum time period for graft copolymerization was found to be 2 h. Water swelling capacity, metal ion sorption, flocculation and resistance to biodegradability studies of synthesized graft copolymer have been performed with respect to the parent polymer. The synthesized graft copolymer has been characterized by FTIR spectroscopy and thermal analysis. Keywords, graft copolymer/ CMTKG / Meth acrylic Acid / potassium bromate / thiourea

## **Advanced Functional Nanomaterials for Biomedical Applications**

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### **Abstract:**

Nanotechnology has made significant strides in biomedical research over the past few decades. Materials at the nanoscale offer unique and highly adjustable physicochemical properties that enable various unconventional applications not feasible at larger scales. Recently, these materials have been combined with other technologies, leading to multiscale behaviors crucial for applications requiring multiple functionalities. Consequently, the development of hybrid multifunctional nanomaterials has sparked innovative breakthroughs in nanomedicine, promising advancements in treating various diseases.

I will delve into the strategic design and synthesis of optical and hybrid multifunctional nanomaterials for biomedical purposes, including diagnostics, therapies, drug delivery, theranostics, biosensing, and regenerative medicine. Certain nanoparticles like perovskite, gold, and carbon-based materials offer both therapeutic and imaging capabilities. Gold nanoparticles, for instance, are effective biosensors due to their surface plasmon resonance properties. Active ingredients, drugs, or nanoparticles can be encapsulated in hydrogels, liposomes, capsules, or polymeric nanocapsules. Nanomaterials can be broadly categorized into inorganic, organic, and biological types.

Examples of organic/biological nanomaterials include cell-derived vesicles, lipid nanoparticles, polymer nanoparticles, dendrimers, amino acid-assembled nanoparticles, nucleic acid nanoparticles, and hydrogel nanoparticles. The most promising aspect lies in combining different materials to meet diverse practical needs. A significant challenge in nanomedicine is designing targeted nanoplateforms for diagnosis, therapy, and imaging (theranostics) tailored to each patient and disease. For instance, van der Ven et al. developed an injectable hydrogel system delivering gold nanoparticle–miRNA drug complexes for heart disease treatment. Besides creating novel functional nanomaterials, researchers are increasingly integrating their innovations with the specific requirements of translational medicine, such as using a nanoclay-containing hydrogel to enhance muscle proliferation and differentiation.

**Prevention of Accidents in Laboratory**

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**Abstract:**

Accidents are unplanned, unintended and unexpected events that result in injury loss or harm. Accidents are always undesirable and prevention of accidents in laboratory should be an integral part of working in laboratory. A safe laboratory always gives better results than an unsafe environment. Understanding of the prevention of laboratory accidents is integral to any scientific discipline, has legal aspects, and is a skill that employers expect scientists to have. HIRA (Hazard Identification and Risk Assessment) is very important tool which helps in prevention of accident in any research work or laboratory experiment.

**Keywords:** Laboratory accidents, Hazard Identification and Risk Assessment, Hierarchy of Control, safety measures, housekeeping, Safety Training, PPEs

## **Desulfurization of Fuels via Ternary Deep Eutectic Solvents**

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### **Abstract:**

Transportation fuels such as diesel consist of refractory organic sulfur compounds, and these refractory sulfur compounds contribute significantly to environmental pollution by the emission of sulfur oxide, hence contributing to global warming. Environmental regulation allows only a lower level of these refractory sulfur compounds in transportation fuels. Diesel has these sulfur compounds, which involve benzothiophenes (BT), dibenzothiophenes (DBT), 4,6-dibenzothiophenes (4,6-DMDBT), etc. Currently, refineries use the conventional hydrodesulfurization (HDS) process, which requires high hydrogen pressure and high temperature. The HDS process can not reduce these refractory sulfur compounds while also increasing the cost due to high temperature and pressure conditions. Thus, an efficient and cost-effective desulfurization process is needed. Another alternative to desulfurization is the solvent extraction method, which requires ambient temperature and pressure along with a suitable polar solvent. Nowadays, deep eutectic solvents (DESs) come in an excellent picture for desulfurization by researchers. In this regard, a ternary DES was synthesized and characterized by Fourier Transform Infrared Spectra (FTIR) using anhydrous ferric chloride, phenylacetic acid (PAA), and triethylene glycol (TEG) in the different mole ratio. The impact of this DES was studied in the removal of sulfur compounds from model fuel containing DBT, and found that the DES has an extraction efficiency of 46%. This extraction efficiency can further be enhanced by up to 97% when carrying multiple extractions (i.e., up to the fifth stage). Thus, the DES containing ferric chloride/PAA/TEG is able to reduce these refractory sulfur compounds from fuel.

**Keywords:** Desulfurization; Solvent Extraction, Extractive desulfurization, ternary Deep Eutectic solvents

## **Delving into Obesity's Molecular Riddles: Examining Resveratrol's Intervention in TLR4/MyD88/NF- $\kappa$ B/iNOS Signaling for Vascular and Cardiac Health**

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### **Abstract:**

**Background:** Obesity is linked with heightened expression of Toll-like receptor 4 (TLR4), a pivotal pattern recognition receptor, which could trigger NF $\kappa$ B/iNOS signaling via MyD88, initiating inflammatory reactions. This sequence of events is implicated in the development of myocardial and vascular abnormalities.

**Methods:** Molecular docking analysis was utilized to investigate the interactions between potential targets (TLR4, MyD88, NF $\kappa$ B, iNOS) and resveratrol. Wistar rats were administered resveratrol orally at a dose of 20 mg/kg/day for a duration of ten weeks to evaluate its therapeutic potential against high-fat diet (HFD)-induced obesity, vascular endothelial dysfunction (VED), and myocardial infarction (MI). The assessment of serum biomarkers involved the use of ELISA kits to measure parameters such as oxidative stress and inflammatory cytokines, followed by tissue histopathology. Mechanistic insights into the TLR4/MyD88/NF $\kappa$ B/iNOS signaling cascade were elucidated using lipopolysaccharide stimulation and protein expression analysis.

**Results:** Our in-silico analysis unveiled significant protein-ligand interactions of interest. Subsequent examination of lipopolysaccharide and protein expression affirmed the involvement of the TLR4/MyD88/NF $\kappa$ B/iNOS signaling cascade in both obese and treated rats. Remarkably, pretreatment with Resveratrol exhibited a pronounced protective effect against cardiovascular and vascular damage, as indicated by the reduction in expression levels along the TLR4/MyD88/NF $\kappa$ B/iNOS pathway."

**Conclusion:** This study underscores the pivotal role played by TLR4/MyD88/NF $\kappa$ B/iNOS signaling in the pathogenesis of cardiovascular complications linked to obesity. It highlights the therapeutic potential of resveratrol in attenuating both vascular endothelial dysfunction (VED) and myocardial infarction (MI). Through molecular docking analysis, we gain insights into the intricate mechanisms underlying resveratrol's actions. Furthermore, in vivo experiments provide compelling evidence validating its protective effects. These findings elucidate resveratrol as a promising candidate for mitigating obesity-related cardiovascular disorders.

**Advanced Study on Smart Nanomaterial Based Sensors for The Detection of Toxic Analytes in Water Produced from Petroleum Industry**

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**Abstract:** As today we have more focused on other sources of energy but due to limited technology and competitive economic races had limited us to still focusing on petroleum products for various industrial, vehicular and domestic source of energy. Petroleum is used in manufacturing a vast variety of materials essential for modern life, The hydrocarbons which processed in refineries for getting various important products for energy have utilizing large amount of water produces big quantities of wastewater called produced water and, it is declared that the oil refinery aquatic wastes reach about one and a half times of produced crude oil contains toxic organic and inorganic analytes which leads environment pollution. The earlier diagnostics of the produced water may provide the correct measure to handle it. But because of inherent complexity and lack of reliable analytical techniques the understanding of produced water composition is limited. Chemical and photometric methods are available to finding the water oil and toxic analytes like to measure dew temperature measurement when the saturated oil experiences a temperature decrease, it reaches a point where water will not condense into a free provided oil in water. Visual crack test (VCT) is an effective test for identifying free and emulsified water down to say 500 mg/l, but the above test is no quantitative and fairly subjective. Photometric analytical method like Fourier transform infrared spectrophotometer may be an effective method for examining samples containing more than 1,000 ppm water, provided an accurate new oil baseline is available for spectral subtraction but it is not sufficient in many situations where accurate water concentrations less than above. The amount of oil in water is monitored by the ultraviolet fluorescence method, and the concentration of oil in water is quantitatively analyzed according to the fluorescence intensity of the oil and its aromatic hydrocarbon compound and the conjugated double bond compound that absorbs ultraviolet light but the ultraviolet fluorescence method were able to detect oil toxins for at least two weeks under standard conditions, but due to the presence of CDOM, turbidity and algae-derived substances may have significantly impairing detection capabilities. But nanomaterial based sensor technology can be very effective to detect oil toxicity in water at very low level of concentration less than 20 ppm even in presence of various interferences. Many researches have shown that metal nanoparticles of Ag, Fe and Zn and metal oxides of TiO<sub>2</sub>, ZnO and iron oxide, carbon nanotubes (CNTs), GOx and nanocomposites play important roles in sensor technique. Nanomaterials possess high surface to volume ratio, high sensitivity and reactivity, improved catalysis and high adsorption properties as well as high reactivity making them suitable for use in sensors for the improved analysis of produced water.

This paper presents a mapping of quantitative developments on produced water studies with a focus on detection limits by nanomaterial based sensors for produced water analytes from petroleum sector.

**Study of Cavitation Treatment in E20 Gasoline by Advanced  $^1\text{H}$  PFGSE-Diffusion NMR**

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**Abstract:**

To address the loss of fuel efficiency in E20 gasoline (gasoline containing 20% ethanol and 80% gasoline), technologists are exploring two concerted approaches to enhance combustion efficacy. One being optimization of engine parameters towards better utilization of enhanced octane properties of ethanol and second would be nullifying the higher cavitation in E20 blends inside the combustion chamber. Study the formation of cavitations, a multicomponent process, by conventional analytical techniques is challenging as the changes are mostly physical and meta-stable in nature. Translational diffusion behavior of molecules can be studied by advanced PFGSE-diffusion NMR (DOSY). Here, in the work, we are presenting the result of a study that investigates the effect of a treatment in E20 gasoline whereas the fuel efficiency of the treated sample has been found to be up by 3-4% when used in internal combustion engine. The effect of the treatment was then studied by advanced PFGSE  $^1\text{H}$  DOSY NMR. The use of DOSY NMR can reveal the nature of hydrodynamic cavitation and the effect of treatment on the cavitation. E20 physical blends and its treated version were studied separately. DOSY NMR revealed the nature of Ethanol-Gasoline interactions by understanding their diffusion behavior. Significant differences in the diffusion behaviour of ethanol molecules before and after the treatments were observed. While in un-treated sample ethanol and gasoline molecules show no interaction and diffuse discretely, the treated samples show significant interactions with faster diffusion. This indicates that these two components are in a state of molecular dissolution after the treatment. Results of this study will be presented.

**Key words:** E20 Gasoline, Cavitation Treatment, Diffusion NMR, Fuel Efficiency.

## **Demonstration of Plastic Degrading Efficacies of Coleopteran and Lepidopteron Insects**

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### **Abstract:**

Plastic is an artificial polymer obtained from conservative petrified oil, which is defiant to biodegradation. Of the total plastic, about 92% is PE (Polyethylene) and PP (polypropylene), both of which are widely used in wrapping and covering. With the overproduction and poor plastic waste management it's causing a trouble in environment. Since 1950, about five thousand eight hundred (5800) MN tons of primary plastic is discarded, which is no longer in use, and only nine percent has been recycled. By 2015, total 8,300 Mt of primary plastic produced globally, out of it 500 Mt (~6%) were recycled, 700 Mt (~9%) were burned, 2,500 Mt (~30%) were still in use and 4600 Mt (~55%) were estimated to have been discarded, ultimately accumulating in landfills and natural environments. Research suggests that plastic waste was landfilled and only 18% recycled. With the uncontrolled application of plastics and rising insistence being put down on methods convenient for plastic wither disposal, the call for biodegradation of plastic and biodegradable plastics wastes has presumed growing significance lately. Plastic biodegradation can be described as degradation of plastic films by microbes present in the gut of some insect species belonging to order Coleoptera and Lepidoptera. The well-known examples of Insects that can degrade plastic is the *G. mellonella* (wax moth), a lepidopteran and *T. molitor* (mealworm), a coleopteran. Some studies have suggested that the larvae of mealworms can consume and break down certain types of plastic, such as polystyrene foam, into smaller fragments by chewing, which is then further broken down in their gut by micro biome. The larvae of *G. mellonella* can also break down certain types of plastic, particularly polyethylene. The enzymes and gut microbes play an important role in biodegradation of polyethylene.

## **Adsorption Approaches for Cleaner Kitchen Wastewater: Challenges and Opportunities for Creative Use of the UV-VIS Spectrophotometer**

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### **Abstract:**

One promising strategy for reducing water pollution, especially in residential settings, is the removal of toxins by adsorption techniques. An overview of current developments in the removal of common pollutants from kitchen wastewater through the use of adsorption techniques is provided in this abstract. Untreated discharge of kitchen wastewater into water bodies or sewage systems can have detrimental effects on water quality and environmental health due to the presence of numerous contaminants such as organic compounds, fats, oils, grease (FOG), detergents, and food particles. Utilizing adsorbent materials to draw these pollutants out of aqueous solutions, adsorption techniques provide an efficient and eco-friendly way to eliminate them from the environment. New materials for adsorbents that are specifically designed to remove certain toxins from kitchen wastewater have been the subject of recent study. Adsorption capabilities and selectivity towards organic pollutants, FOG, and other dissolved chemicals have been studied for natural materials such as activated carbon, zeolites, clay minerals, and adsorbents generated from agricultural waste. Furthermore, because of their large surface areas, chemical functionalities, and tuneable qualities, innovative materials such as metal-organic frameworks (MOFs), biopolymer-based adsorbents, and graphene-based nano materials have demonstrated potential adsorption performance. In order to maximise adsorption efficiency and minimise operating costs, adsorption procedures can be further improved by process optimisation, which includes adjusting pH, temperature, contact time, and adsorbent dosage. By prolonging their lifespan and lowering waste production, regeneration and reuse of adsorbents also provide advantages for the environment and the economy. Cost-effective ways to improve water quality and lessen the environmental impact of kitchen wastewater discharge can be found by integrating adsorption techniques into residential wastewater treatment systems, such as under-sink filtration units, point-of-use devices, or decentralised treatment units. When implementing adsorption-based treatment technologies in a residential setting, it is important to take into account aspects like ease of use, maintenance needs, and compatibility with the current plumbing infrastructure. All things considered, the removal of pollutants from kitchen wastewater through the application of adsorption techniques has the

potential to improve water quality, safeguard ecosystems, and encourage sustainable water management strategies in residential settings. To solve the problems associated with treating kitchen wastewater and support international initiatives for pollution control and water conservation, more research and innovation in this field are needed in order to provide effective, economical, and scalable solutions.

**Key words :-** Water Pollution, adsorption method, and kitchen trash.

**UPLC-Q-TOF-MS/MS and HPLC-ELSD Based Chemometric Approaches for Marker Compound Identification in *Trillium govanianum* Wall. Ex D. Don (NagChhatri): Inference for Medicinal Properties and Genetic Stock Improvement**

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**Abstract:**

*Trillium govanianum* Wall. ex D. Don, commonly known as Nag Chhatri or Himalayan trillium. It is a highly valued medicinal plant belonging to the Melanthiaceae or Trilliaceae family and it is found in the Himalayan Region, at altitude ranging from 2400–4000 m. This plant is distributed across Pakistan, India, Nepal, Bhutan, and China. In India, it is distributed in the Himalayan states namely Jammu & Kashmir, Union Territory Ladakh, Himachal Pradesh, Uttarakhand, and Sikkim. *T. govanianum*, an ecologically specialized species, thrives in shaded microenvironments under rocks or dense tree/shrub canopies. In the temperate Himalayan forests, this species is often found among the canopy of mixed forests containing species such as *Quercus*, *Abies* spindrow, *Juglans* regia, *Cedrus* deodara, *Betula*, *Rhododendron*, *Juniperus* indica, and *Salix*. Conversely, in sub-alpine regions, it shows a preference for *Rhododendron* canopies. This medicinal plant thrives in moist, organic-rich soil with a gradual decomposition of litter. In traditional therapy, it has been used to treat various ailments such as dysentery, wounds, skin boils, inflammation, sepsis, as well as menstrual and sexual disorders. Economically, the trade values and prices of its rhizomes have significantly risen, reaching up to Rs. 3,000 kg<sup>-1</sup> in the Indian market and USD 50–315 kg<sup>-1</sup> in the international market. *Trillium govanianum*, a medicinal herb, exhibiting diverse morphometric traits and phytochemicals across developmental stages of plants. The changes in the chemical profile and steroidal saponin levels in the rhizome of *T. govanianum* across different developmental stages were previously unknown. Given these facts, the present study aims to: (i) extraction and fractionation of saponins from diverse morphotype rhizomes of *T. govanianum*; (ii) provide a quantitative characterization of specialized saponins in various fractions from diverse morphotype rhizomes of *T. govanianum*; and (iii) unveiling pharmacological potential of the saponin-rich fractions through in-silico analysis followed by in vitro biological activity.

This study categorizes rhizomes into three types based on scar presence: juvenile (5–10 scars, Type I), young (11–19 scars, Type II), and mature (21–29 scars, Type III). Rhizomes show varying sizes (length 1.2–4.7 cm, girth 0.3–1.6 cm), weight (0.18–5.0 g), and extractive yields (9.7–16.1 % w w<sup>-1</sup>), with notable differences in saponin content (5.95–21.9 mg g<sup>-1</sup>). Ultra-high performance liquid chromatography–MS/MS (UHPLC–QTOF–MS/MS)-based chemical profiling identifies 31 phytochemicals, mainly including diverse saponins. Ultra-high performance liquid chromatography coupled with evaporative light scattering detection

(UHPLC–ELSD)-based quantitative analysis of seven key saponins reveals stage–specific accumulation patterns, with protodioscin (P) and dioscin (DS) predominant in mature rhizomes.

Statistical analysis confirms significant variation ( $p=0.001$ ) in saponin levels across developmental stages with chemical constituent protodioscin ( $P=4.03\pm0.03$ – $15.76\pm0.14\text{mg g}^{-1}$ ,  $P_{\text{Ave}}=9.79\pm3.03\text{ mg g}^{-1}$ ) and dioscin ( $DS=1.23\pm0.06$ – $3.93\pm0.07\text{ mg g}^{-1}$ ,  $DS_{\text{Ave}}=2.59\pm0.70\text{ mg g}^{-1}$ ) with acceptable power ( $p=0.738$ ;  $|\delta|>0.5$ ) statistics for effective sample size ( $n=27$  samples used in the study) of *T. govanianum*. Principal Component Analysis (PCA) and Euclidean clustering further highlighted chemotype distinctions. Phytochemical analysis reveals unique metabolite profiles in each stage.

The PASS online platform was utilized to perform the in-silico pharmacological activity profiling of the above quantified selected compounds. The outcomes showed activity scores that represented each compound's chance of displaying particular pharmacological properties, such as antioxidant, antiviral, antifungal, and antibacterial properties. In terms of antifungal activity, protodioscin, showed 0.784, antibacterial activity with 0.602, and antiviral activity against influenza (0.509), herpes (0.368), rhinovirus (0.399), and hepatitis (0.223). In a similar vein, the antifungal, antibacterial, and antiviral properties of dioscin and prosapogenin B demonstrated activity against influenza, herpes, hepatitis B, and trachoma. Diosgenin showed potential antibacterial and antiviral activity against herpes, rhinovirus, and influenza. Based on the activity score Dioscin, has highest pharmacological activity as compared to rest of compounds listed. These findings enhance understanding of *T. govanianum*'s phytochemical dynamics, thereby facilitating targeted genetic stock improvement and utilization for therapeutic purposes.

**Keywords:** Biological activity, Phytochemical, Morphometric, Steroidal saponins, *Trillium govanianum*.

## **Synthesis and Evaluation of Poly(acrylate-co-benzyl maleate) Copolymers as Wax Deposition Inhibitors for Crude Oil**

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### **Abstract:**

Wax precipitation and deposition during crude oil transportation through pipelines pose significant flow assurance challenges. According to the American Petroleum Institute (API), crude oil has been categorized into three types: 1. Heavy crude oil (API < 29) 2. Medium crude oil (API < 38), and 3. Light crude oil (API > 38). Among these crude oils, heavy crude oil, due to the presence of high wax content, faces the major challenge of flow assurance under low temperature conditions. As the temperature of crude oil falls below the wax appearance temperature (WAT), the paraffin wax present in the crude oil separates in the form of crystals and begins to agglomerate at the walls of the pipeline or the vessels. As a result, there is a reduction in the effective diameter of the pipeline, leading to restricted flow of crude oil or, under severe conditions, pipeline blockage.

Therefore, the present work focused on synthesizing a range of poly(C<sub>22</sub>Ac-co-BM) copolymers (P1, P2, and P3) derived from fatty alcohol acrylate (C<sub>22</sub>Ac) and benzyl maleate (BM) through free radical polymerization (FRP). These copolymers were designed to serve as efficient wax inhibitor (WI) additives for crude oil. The detailed characterization of these additives was carried out using structure-sensitive techniques such as <sup>1</sup>H-<sup>13</sup>C NMR, FT-IR, TGA, DSC, and GPC. The paraffin inhibition efficiency (%PIE) of these additives was investigated using pour point, cold finger, and flow loop experiments. The findings revealed a pour point reduction of branched line crude oil (BLCO) doped with P1, P2, and P3 ranging from 17-67% and wax inhibition between 40-68%. Among the synthesized poly(C<sub>22</sub>Ac-co-BM) copolymers, P2 displayed the most promising performance, demonstrating a 67% reduction in pour point and a substantial 69% reduction in BLCO wax deposition.

## **Preparation of Zeolite ZSM-5 from Coal Waste Material (CWM) and Its Application in Methane Dehydroaromatization**

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### **Abstract:**

Herein, we have studied the process of making the ZSM-5 from coal waste material (CWM). Generally, CWM is used in Cement production, mine filling, brick and tile production, reclaiming low-lying area highways and flyovers, and agriculture. Nevertheless, 21.86% of India's total CWM still needs to be utilized. A large landfill area is needed to properly dispose of the CWM, which can have adverse environmental effects. CWM includes Fly ash as well as bottom ash. Alumina and silica are present in large quantities in Indian CWM (around 51.39% combined), and these are necessary ingredients for making zeolite ZSM-5. ZSM-5 requires an organic structure directing agent (OSDA). Thus, we used the hydrothermal technique to create mesoporous zeolite ZSM-5. In a Teflon-lined stainless steel autoclave, zeolite ZSM-5 was synthesized by utilizing CWM and OSDA tetra propyl ammonium hydroxide (TPAOH) at a crystallization temperature of 120-180°C for 48-120 hours. The surface area of the zeolite ZSM-5 was created with a range of 250-350 m<sup>2</sup>/g. The yield range is 20–30% overall. Zeolite ZSM-5 is a catalyst that is used in the petrochemical industry to break down hydrocarbons into shorter-chain hydrocarbons, as well as in other ion exchange applications, organic solvent drying agents, gas separation and long-term toxic waste storage. The prepared zeolite was used as a support in the preparation of a molybdenum-supported zeolite ZSM-5 catalyst for the reaction 'methane dehydroaromatization (MDA)'. Reaction conditions are GHSV 1700 mlg<sup>-1</sup>h<sup>-1</sup> and catalyst loading 0.3gm with a 4:1 CH<sub>4</sub> to N<sub>2</sub> ratio. This reaction's conversion and benzene selectivity were 3% and 40 %, respectively.

**Keywords:** Coal waste material, zeolites, ZSM-5, methane dehydroaromatization, MDA

## Improving the Oxidation Stability of UCO-Biodiesel Using Metal Deactivators

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### Abstract:

In recent years, the energy for global economic expansion has been solely based on fossil fuels, which are fast diminishing and causing environmental deterioration. This predicament has raised the interest of several governments across the world in developing alternative biofuels to replace petroleum fuels. Biodiesel or alkyl ester is being prioritized for production from edible, non-edible, and microalgal oils as feedstocks. Biodiesel is more prone to oxidation or autooxidation during long-term storage than traditional petrodiesel. European biodiesel standard EN-14214 requires assessing oxidation stability at 110°C with a minimum induction duration of 6h using the Rancimat technique (EN-14112). The use of additives like tert-butylated hydroxytoluene (BHT), tert-butyl hydroxyl quinone (TBHQ), tert-butylated hydroxyanisole (BHA), propyl gallate (PrG), and pyrogallol (PY), is a popular strategy to address this problem in biodiesel. With the limited availability of non-vegetable oil resources, used cooking oil has been an emerging feedstock for producing sustainable fuel like bio-diesel. The UCO-biodiesel was also found to have average oxidation stability. The metal content is also found to be high in comparison to other biodiesel, such as jatropha biodiesel. Since the metal ions could also catalyze oxidation, metal deactivators were synthesized in this work to increase the oxidation stability and fulfill the aforementioned criteria necessary for oxidation stability in biodiesel specification. Here, this paper describes the synthesis of metal deactivator 2,2-((1E,1E)-(propane-1,2-diylbis(azaneylylidene))bis(methaneylylidene))diphenol (MDA-1), 2,2-((1E,1E)-(propane-1,2-diylbis(azaneylylidene))bis(methaneylylidene))bis(4-(tert-butyl)phenol) (MDA-2), 6,6-((1E,1E)-(propane-1,2-diylbis(azaneylylidene))bis(methaneylylidene))bis(2,4-(tert-butyl)phenol) (MDA-3), by reacting 1,2-diamino propane with different types of hydroxy benzaldehyde, in methanol solvent. Various spectroscopic techniques like FT-IR and NMR confirm the synthesis of additives. The performance of synthesized additives MDA-1, MDA-2, and MDA-3 was assessed in UCO biodiesel. The synthesized additive effectively enhanced the oxidation stability of UCO-biodiesel. Neat UCO biodiesel exhibited oxidation stability of 5.12 h. The synthesized additives were blended into biodiesel in varying concentrations. MDA-1 was found to show the best performance as it increased the induction period from 5.12 to 6.87 at 600 ppm.

## **Biodegradable Flexible Electronics: A Comprehensive Study on Graphene Reinforced Natural Polymer Composites**

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### **Abstract:**

With the increasing demand for Internet of Things (IoT) products in the global market, vast amounts of electronic waste (commonly known as "e-waste") are generated in developed and developing countries. India alone produces approximately 1,641 metric tons of e-waste each year. This environmental issue underscores the need for biodegradable flexible electronic devices, which would have positive financial and environmental impacts. Traditional materials used in high-performance electronic devices include a variety of synthetic polymers such as polyethylene terephthalate (PET), polyimide (PI), and polydimethylsiloxane (PDMS). However, these materials have significant limitations, including non-biodegradability and potential toxicity. These drawbacks make them unsuitable for several applications. Therefore, chitosan, a natural polysaccharide has emerged as a promising alternative for creating flexible electronic devices. It offers several advantages such as biocompatibility, non-toxicity, and biodegradability. However, its electrical and mechanical properties are not sufficient for use in flexible electronics. To resolve this, graphene nanofiller is often used to improve physicochemical and electrical performance owing to its excellent physical, electrical, and mechanical properties. By combining graphene with chitosan through a simple solvent-casting method, a low-cost, flexible substrate is created. The primary aim is to investigate the mechanical, chemical, and physical properties of graphene-reinforced chitosan polymer composites. It explores various aspects such as flexibility, biodegradability, toughness, mechanical stability, thermal stability, and the current-voltage relationship, using analytical techniques like Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM/EDX), thermogravimetric analysis (TGA), X-ray diffraction (XRD), and current-voltage (I-V) relationship.

**Keywords:** Chitosan, Biodegradable composites, Solvent casting, Current-Voltage relationship

**Unlocking the Potential of Household Bio-Waste for Energy Storage Applications: Comparative Study of Potato Peel and Jackfruit Peel-Derived Activated Carbon**

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**Abstract:**

Activated carbon, renowned for its intricate porous structure and expansive surface area, serves as a useful material in numerous industries including energy storage devices, medicinal applications and electronic devices. Particularly in the domain of super capacitor technology, where the intricate interplay between pore density and surface architecture significantly influences the properties of activated carbon. This research mainly includes a comparative analysis of activated carbon derived from two prevalent household biowaste sources: potato peels and jackfruit peels. The investigation focused on elucidating the influence of optimization parameters and activating agents on the properties of these activated carbons, with a specific emphasis on their suitability for energy storage devices, particularly supercapacitors. Characterization techniques including scanning electron microscopy (SEM), X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and Thermogravimetric analysis (TGA) were employed to analyze the morphology, crystallinity, surface chemistry, thermal stability and pore structure of the activated carbon. In conclusion, this research underscores the importance of optimization parameters and activating agents in tailoring the properties of household biowaste-derived activated carbon for energy storage devices. The insights gained from this study provide valuable guidance for the design and development of sustainable and high-performance materials for energy storage applications, contributing to the advancement of renewable energy technologies.

**KEYWORDS**

Activated Carbon; Supercapacitors; Energy storage devices; Household biowaste

## **Biowaste-Mediated Green Synthesis of Silver Nanoparticles and Its Catalytic Application**

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### **Abstract:**

Nanoparticle synthesis using plant extract gives alternatives to conventional methods with the advantage of cost-effectiveness and low toxicity. Onion peels are a good source of polyphenols but are usually discarded. In this research work, onion peel extract was utilized for the synthesis of silver nanoparticles (OP-AgNPs). When onion extract was added to the silver nitrate solution, the color changed to reddish brown, indicating the formation of silver nanoparticles. The characterization of OP-AgNPs was evaluated using UV spectroscopy, and Scanning Electron Microscopy (SEM) techniques. The surface plasmon resonance (SPR) of OP-AgNPs was observed at 420 nm. SEM images showed the nanoparticles ranged from 16-41 nm. The synthesized OP-AgNPs exhibited a promising catalytic activity for rhodamine B dye degradation. The degradation of dye followed pseudo-first-order kinetics with a good rate constant.

**Keywords:** Biowaste, Onion peel, catalytic, Rhodamine-B, Silver nanoparticles

## Optimization of CO<sub>2</sub>/CH<sub>4</sub> Adsorption Selectivity of Acid Activated Clay with Response Surface Methodology

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### Abstract:

Natural layered clay, such as bentonite, when chemically modified with inorganic acid are transformed in materials with enhanced surface area and porosity. These enhanced properties make acid activated clays more effective, for various industrial applications involving adsorption, catalysis, and purification processes. In this study, the acid activation of layered clay was optimized for biogas purification (CO<sub>2</sub>/CH<sub>4</sub>) separation, by using Response Surface Methodology (RSM). The three critical parameters, such as acid concentration, temperature, and contact time were investigated to determine their influence on the adsorption selectivity. For this purpose, five level, three factor central composite design (CCD) was utilized to model the response surface and a quadratic polynomial equation was generated to predict the optimal conditions. The surface and structural properties of optimized material were extensively characterized using N<sub>2</sub> adsorption-desorption, XRD, FTIR, and TGA. High pressure adsorption isotherm (upto 10 bar) for CO<sub>2</sub> and CH<sub>4</sub> were measured at constant temperature (25°C) on the prepared material, and fitted with Sips isotherm model. The adsorption selectivity was calculated using ideally adsorbed solution theory (IAST) for CO<sub>2</sub>/CH<sub>4</sub> binary mixture. The results demonstrate a significant impact of activation conditions on the adsorption selectivity of acid-activated clay for biogas up gradation, leading to improved process performance and cost-effectiveness. This study contributes to the advancement of sustainable and economical biogas purification technologies by offering valuable insights for the development of efficient endless chemical intensive adsorbent for biogas purification.

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Keywords: Acid treatment, Adsorption, Biogas, Selectivity, IAST, Response Surface Methodology

**Physicochemical Analysis of Bifonazole and Cationic Surfactant CTAB: Thermodynamic Parameters in Hydro-Ethanollic Solvent Systems**

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**Abstract :**

Thermodynamic investigations of the well-recognized antifungal drug bifonazole and lecithin with cationic surfactant CTAB have been established. Lecithin, a phospholipid, is a major structural component of ethosomes. Lecithin has amphiphilic properties, meaning it has both hydrophilic and lipophilic regions. This property allows ethosomes to encapsulate a wide range of drugs. However, the concentration of more than 40% ethanol shows extremely limited solubility of lecithin. Extensive research has been conducted on the characteristics of micellar systems that demonstrate diverse hydrophobic and hydrophilic interactions. The experiments were conducted using five distinct hydro-ethanollic concentrations, namely 0% v/v, 10% v/v, 30% v/v, 70% v/v, and 90% v/v ethanol, throughout a range of five temperatures (ranging 20 °C, 25 °C, 30 °C, 35 °C and 40 °C with an increment of 1mg drug concentration). The study involved the determination of several parameters, including surface tension ( $\gamma$ ), density ( $\rho$ ), conductivity ( $\kappa$ ), contact angle ( $\theta$ ) and surface free energy. Conductivity and surface tension data was used for calculating critical micelle concentration (CMC). CMC was utilised to calculate various thermodynamic properties, such as the standard enthalpy change ( $\Delta H^\circ$  m), standard entropy change ( $\Delta S^\circ$  m), and standard Gibbs energy change ( $\Delta G^\circ$  m) of micellization. This study represents a comparative analysis of the critical micelle concentration (CMC) by utilising conductivity and surface tension measurements. Contact angle is used to determine the hydrophobicity and hydrophilicity of the system. These investigations are valuable for examining the magnitude of hydrophobic interactions within the system, which might be used to ascertain an optimal concentration of bifonazole, lecithin and surfactant to prepare ethosomal formulations.

**Keywords:** CTAB; Critical micelle concentration; thermodynamic parameters; surface free energy; contact angle.

## **Adsorptive Desulfurization of Light Crude Oil from Kitchen Waste: A Cost Effective and Sustainable Solution**

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### **Abstract:**

Production of clean fuel from crude oil is a challenging and crucial task for oil refineries. Refining results in not only high processing cost but also has a damaging effect on the equipment, on the quality of the refinery products and also on the environment. Current technologies used for removal of high sulfur involve costly methods and are also not environmentally friendly. Adsorptive desulfurization (ADS) is a green and low energy consumption technique which selectively and effectively removes sulfur from the crude oil. Some of the adsorbents used so far in ADS have been activated carbon (AC), zeolites, metal-organic framework (MOF), graphene oxides, natural clays, metal-oxides etc. Kitchen waste has been identified as effective precursor for development of activated carbon for possible use in ADS of crude oil. In this respect, the unscientific solid waste management of kitchen waste have been identified as leading source of global warming, climate change and subsequent health risks. The present study has addressed the synthesis and application of chemically activated carbon from kitchen waste as a robust adsorbent for the desulfurization of light crude oil. Crude oil sample was acquired from Indian Institute of Petroleum (IIP), Dehradun. The sulfur content in light crude oil was analyzed by XRF and it was found to be 680 ppm. The fabrication involved an initial biochar synthesis at 500°C followed by chemical activation with ZnCl<sub>2</sub> and then pyrolyzed at temperature of 700°C under inert conditions. The fabricated activated carbon showed remarkably high pore diameter of 3.143nm, pore volume of 0.38 cc/g and a surface area of 110.734m<sup>2</sup>/g. Batch adsorption studies demonstrated high sulfur removal efficiency of 41.7% involving an adsorbent dosage of 0.8g. The time taken to achieve the desired desulphurization was 6 hrs. The preliminary findings demonstrated the effectiveness of kitchen waste as a precursor for high-quality adsorbents required for the desulfurization of crude oil. The study has demonstrated the potential and dual role of kitchen waste in waste management as well as in desulfurization of crude in a cost-effective and sustainable manner. The study promotes the paradigm of waste valorization highlighting the possibility of pollution reduction through sustainable practices, by turning kitchen waste into a useful resource for environmental restoration. This innovative strategy is in compliance with waste management plans and sustainable development goals since it promotes the use of waste products to achieve better resource efficiency while improving the environment.

**Keywords:** Adsorbent, Kitchen waste, Desulfurization, Sustainable, Cost-effective.

**Metal-Organic Framework Adhered Fiber for Analysis of Sulphur Mustard By HS-SPME-GC in Soil Sample**

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**Abstract:**

Metal organic framework (MOF) have wide application in the field of adsorption and degradation of chemical warfare agents and can be used for sample preparation and chromatographic separation from various matrices. Here, we fabricated solid phase microextraction (SPME) fiber by sequentially coating of MOF UiO-66 on stainless steel stylet via simple direct adhesion method and applied for the determination of toxic sulphur mustard in soil. Quantitative analysis was performed using gas chromatogram coupled with flame photometric detector (GC-FPD). Synthesized MOF was also characterized by FE-SEM, EDEX, XRD, TGA, DSC, and FT-IR. Fiber extraction and desorption condition of headspace SPME (HS-SPME) were achieved by sampling headspace obtained by spiking 5 µg of sulphur mustard dissolved in high volatility solvent in 10 gm of soil. The optimized parameters, temperature (35-80°C) and time of extraction (30-150 min) were obtained at 60°C and 120 min conditioning of fiber for the selected analyte. The repeatability for one fiber (n=7) and fiber-to-fiber reproducibility (n=5) expressed as relative standard deviation were 3.2% and 8.5% respectively. The results of easily and inexpensively lab prepared SPME fiber was also compared with commercially available fiber used for related application which shows better efficiency towards selected analyte.

**Physical Activation of Carbon Prepared from Eupatorium Adenophorum (Crofton Weed): Process Optimization and Antimicrobial Activity**

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**Abstract:**

The invasive weeds compete with native crops for sunlight, water, nutrients and space therefore sustainable management of their biomass is essential. Amongst various options the valorization of weed biomass through viable process is very lucrative. In this study, the biomass of a locally found invasive weed, Crofton weed (*Eupatorium adenophorum*) was physically activated in CO<sub>2</sub> atmosphere. The activation process was optimized with Response surface methodology (RSM), in terms of activation temperature, duration, and CO<sub>2</sub> flow rate. The surface and textural properties of prepared samples were characterized with FTIR and BET Surface area analyzer. Under optimized condition the activated carbon sample shows a surface area of 374 m<sup>2</sup>.g<sup>-1</sup> and pore volume of 0.12 cm<sup>3</sup>.g<sup>-1</sup>. Further, the methanolic extract of two different locally found invasive weeds, which were Crofton weed and Goat weed(*Ageratum conyzoides*) were prepared and characterized phytochemically. The un-activated carbon (Biochar) and optimized activated carbon sample were impregnated with these extracts. The antimicrobial activity of these extracts and impregnated samples was investigated against three commonly found microorganism *Staphylococcus aureus*, *Escherichiacoli*, and *Candida albicans*. The resulting zone of inhibition (ZOI) was measured, where both the weed extracts show significant zone of inhibition against *S. aureusas* compared to other microorganisms. Amongst impregnated samples, the activated carbon demonstrates noticeable antimicrobial activity against *S. aureusas* compared to un-activated carbon sample. The result show that impregnation of invasive weed extract onto physically activated carbon offers a sustainable solution for weed management as well as microbial inhibition.

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**Keywords:** Crofton weed, Physical activation, Biochar, Response surface methodology, Plant extract, Antimicrobial activity

**Synthesis and Luminescent Properties of Heteroleptic Orange-Red Emissive Samarium (III) Complexes: Tuning Optoelectronic Characteristics for Displays Applications**

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**Abstract:**

Ternary Sm(III) complexes of general representation  $[\text{Sm}(\text{TFDH})_3\text{L}]$  were synthesized to understand influence of different auxiliary moieties on their optoelectronic properties. The synthesized complexes were thoroughly investigated using elemental, IR, NMR, UV and PL studies. In these complexes, the emitting metal ion is bonded with six O atoms from di-ketone and two nitrogen atoms from neutral ligand. Proton NMR spectral data showed that samarium ion induced chemical shift is dipolar in nature. The photoluminescence analysis showed that the complexes show intense orange-red emission due to  $^4\text{G}_{5/2} \rightarrow ^6\text{H}_{9/2}$  transition. Moreover, CIE color coordinates supported the results obtained from photoluminescence study, providing additional confirmation of the luminescent properties of prepared complexes within the orange-red region. Their utility in displays and OLED's was confirmed by studying their optical and electronic band gaps.

**Keywords:** Luminescence; 1,10-phenanthroline; Band Gap; Electrochemical Study; Absorption Spectra; Mono-exponential Fit.

## Comprehensive Exploration of Ternary Dy(III) Complexes for White LightEmission: Synthesis and Spectroscopic Analysis

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### Abstract:

Dysprosium ( $\text{Dy}^{3+}$ ) containing two single-molecule complexes with 1,3-diketone ligand, TFPB (4,4,4-trifluoro-1-phenyl-1,3-butadionate) along with neutral ligands of varying denticity were synthesized and were explored as potential sources of near-white light emission. The choice of ligand as well as the coordination surroundings of Dy(III) ion significantly influence the blue (B:  $^4\text{F}_{9/2} \rightarrow ^6\text{H}_{15/2}$ ) and yellow (Y:  $^4\text{F}_{9/2} \rightarrow ^6\text{H}_{13/2}$ ) emissions. The inclusion of the auxiliary ligand such as topo in D1 leads to reduction in emission intensity compared to D4 due to less effective sensitization. At room temperature, the CIE color coordinates for complexes D1 and D4 approach the coordinates of perfectly balanced and idealized white light (0.333, 0.333). In addition to their visible emissions, the semi-conducting properties corresponding to these synthesized complexes (D1 & D4) have also been extensively studied and found potential applications in basic research, security printing, sensors, detectors and OLEDs.

**Design and Evaluation of Red-Emitting Europium(III) Complexes for Advanced Display Technologies: Insights into Spectroscopic Studies**

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**Abstract:**

1,1,1,5,5,5-hexafluoro-2,4-pentanedione (HFAA) based  $\text{Eu}^{3+}$  ion complexes have been prepared incorporating mono and bi-dentate neutral ligands. Various spectroscopic techniques were employed to confirm the coordination environment and spectroscopic properties of the synthesized complexes. The coordination sphere of  $\text{Eu(III)}$  consists of six oxygen atoms provided by HFAA ligands and two atoms from the ancillary ligand. Photoluminescent studies helped to understand the role of ligands on the emission intensity and color. Upon exposure to UV radiation, complexes emitted reddish light, suggesting a significant transfer of energy from the sensitizing moieties to the  $\text{Eu}^{3+}$  ion. This red emission was observed due to  $^5\text{D}_0 \rightarrow ^7\text{F}_2$  transition possessing an electric dipole character. Luminescence decay curves served as the basis for calculating the excited-state lifetimes of the synthesized complexes. Due to their distinctive red luminescence and semiconducting properties, these  $\text{Eu(III)}$  complexes can be employed as red-emitting material for fabricating lighting devices.

**Keywords:** Lanthanide Luminescence; Antenna Effect; CIE Color Coordinates; Photoluminescence; Ternary Complexes.

## Enhancing Luminescence of Europium(III) $\beta$ -diketonates with Ancillary Ligands: Investigating Opto-Electronic Characteristics

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### **Abstract:**

The sequence of five europium(III) complexes incorporating  $\beta$ -diketone TFPB (4,4,4-trifluoro-1-phenyl-2,4-butanedione) as the main ligand and –N and –O donor lewis bases as ancillary ligands have been synthesized and characterized thoroughly using different spectroscopic techniques. A comprehensive evaluation of the energy transfer process is carried out, revealing correlation between the luminescence of emitter Eu(III) ion and triplet-state energy levels of ligands. Among the series of investigated complexes, the complex [Eu(TFPB)<sub>3</sub>(Phenan)] displays the most intense luminescence. Furthermore, the CIE color space coordinates for these complexes are precisely calculated and presented. In addition to their visible emissions, a deep study into the semiconducting properties of these synthesized complexes has also been conducted. As the prepared complexes have red luminous characteristics, conducting behavior investigated *via* absorption and electrochemical analyses explains their potential as red emanating material in OLEDs, photonic and optoelectronic devices.

**Keywords:** Antenna Effect; Diketone; Europium; Luminescence; OLEDs

## **Green Synthesis of Photocatalysts using four different Invasive Plant Species and Comparison of their Photo Degradation Efficiency**

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### **Abstract**

Photocatalysis stands as a promising solution for eliminating persistent pollutants from water and wastewater. However, conventional synthesis routes of photocatalysts often contribute to environmental toxicity. In response, green synthesis, particularly via nanomaterials, has emerged as an eco-friendly and efficient alternative. This study focuses on the green synthesis of TiO<sub>2</sub> nanoparticles using four different invasive plant leaf-extracts, *Ipomoea cairica*, *Solanum viarum*, *Malvastrum coromandelianum*, and *Oxalis debilis* contrasting them with conventionally produced TiO<sub>2</sub>. The extracts served as reducing agents during green synthesis, which act as an alternative of ethanol (used in chemical intensive synthesis), and the titanium tetra-isopropoxide used as precursor for both the synthesis. The sol-gel method facilitated the synthesis, followed by aging and calcination. Characterization of samples with UV-Vis DRS, N<sub>2</sub> adsorption-desorption, and FT-IR spectroscopy confirmed the textural and photophysical properties of TiO<sub>2</sub>. Notably, TiO<sub>2</sub> derived from *I. cairica* exhibited a reduced band gap compared to chemically synthesized TiO<sub>2</sub>. Photocatalytic degradation experiments revealed that all four green synthesized photocatalysts outperformed the conventionally synthesized photocatalyst. The optimized degradation efficiency of *I. cairica*-based TiO<sub>2</sub> against malachite green dye, was achieved at a catalyst dose of 1.5 g·L<sup>-1</sup>, 25 mg·L<sup>-1</sup> initial dye concentration, and 6 pH. This catalyst demonstrated favorable reusability and showed a decline in degradation efficiency with increasing dye concentrations. The kinetics of degradation further elucidated the photocatalytic activity across varying initial dye concentrations. This research underscores the potential of green-synthesized TiO<sub>2</sub> nanoparticles from invasive plants as effective and sustainable solutions for water treatment challenges.

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**Keywords:** Green synthesis, Titanium dioxide, Nanoparticle, Photocatalyst, Malachite green, Invasive weed

## **Current Advances in ER Stress Inhibition with Special Emphasis to Management of Metabolic Syndrome**

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### **Abstract:**

Endoplasmic reticulum (ER) stress has emerged as a pivotal contributor to the pathogenesis of metabolic syndrome, a complex cluster of metabolic abnormalities characterized by insulin resistance, obesity, dyslipidemia, and hypertension. An extensive summary of the most recent developments in ER stress inhibition is given in this abstract, with an emphasis on the possible applications for treating metabolic syndrome. The unfolded protein response (UPR), the primary cellular mechanism activated in response to ER stress, orchestrates a series of adaptive signaling pathways aimed at restoring ER homeostasis. However, chronic or unresolved ER stress can precipitate metabolic dysfunction by promoting inflammation, oxidative stress, and apoptotic cell death. Consequently, targeting ER stress represents a promising therapeutic strategy for ameliorating metabolic syndrome and its associated complications. Numerous pharmaceutical products and dietary modifications have been found to be possible ER stress inhibitors. Chemical chaperones that improve protein folding and reduce ER stress-induced apoptosis, like tauroursodeoxycholic acid (TUDCA) and 4-phenylbutyric acid (PBA), have cytoprotective effects. Moreover, via altering UPR signaling pathways, natural substances including quercetin, resveratrol, and curcumin have shown anti-ER stress characteristics. To conclude, the emerging field of ER stress regulation presents significant opportunities for the management of metabolic syndrome through the reduction of insulin resistance, the mitigation of inflammation in adipose tissue, and the enhancement of lipid metabolism. Nonetheless, additional preclinical and clinical research is necessary to clarify the enduring safety and effectiveness of ER stress inhibitors as possible treatments for metabolic syndrome and its related comorbidities.

## **A Novel G•G•T Unimolecular Triplex, Shaped by Double Repeat of Chlamydomonas Reinhardtii Telomere Sequence**

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### **Abstract:**

Competition among DNA non-canonical structures has been widely studied in repetitive DNA sequences. The factors affecting DNA structural polymorphism have always been an important area of research. The telomeric sequence (TTT TAGGG)<sub>n</sub> of unicellular green alga *Chlamydomonas reinhardtii* is found to be an exception to the general idea of shaping into a folded G-quadruplex topology by a few repeats in any telomeric sequence. Telomeres, the protective ends of eukaryotic chromosomes, are ubiquitous and conserved DNA structures. The basic structural unit of most telomeres, a repeated minisatellite motif with the consensus sequence, may vary between different groups, for example, TTAGGG in vertebrates and fungi, TTTAGGG in plants (*Arabidopsis*-type) and TTTTAGGG in *Chlamydomonas* (a green algae). Herein, using Polyacrylamide gel electrophoresis (PAGE), UV thermal melting, UV thermal difference spectra (TDS), Circular Dichroism (CD), and fluorescence and NMR spectroscopy we demonstrated that the double repeat of the *C. reinhardtii* telomere (TTT TAGGG)<sub>2</sub> (Chlm2) adopts a intramolecularly folded unimolecular non-conventional triplex structure in Na<sup>+</sup> solution. We report that the co-existence of reverse Hoogsteen (G•G) and Wobble base pairing (G•T) stabilizes the triplex structure. To the best of our knowledge, such a non-conventional triplex structure formed by any telomeric sequence has not been reported to date

## **Furfural Production Using Sulfonic Acid-Supported KCC Catalyst for Xylose Dehydration**

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### **Abstract:**

The goal of this research is to produce furfural by employing nano-catalysis to dehydrate xylose, a potentially effective and sustainable method of converting biomass. Traditionally, furfural a useful platform chemical is produced by acid-catalyzed xylose dehydration; however, this method can be difficult and produce unwanted byproducts. The novel approach of nano-catalysis presents a viable answer to these problems.

This work investigates the potential of several nanostructures as catalysts to improve the dehydration process efficiency. Using nanomaterials has a number of benefits, including as greater selectivity, higher catalytic activity, and surface area. In addition to making the process of converting xylose to furfural easier, the nano-catalysts reduce unwanted side reactions, which increases yields and purity. The impact of various nanoparticles, or nanostructures, is methodically studied. The catalytic processes behind the dehydration reaction is made possible by this investigation. In order to optimize furfural synthesis, the study also demonstrates how to optimize reaction parameters like temperature, pressure, and catalyst concentration. The present study examines the catalytic activity, selectivity, and stability of the KCC catalyst supported by sulfonic acid in the xylose dehydration process. One important point to note in this regard is that nano-catalysis is environmentally benign. In keeping with the ideas of green chemistry, the use of nanomaterials lessens the furfural production process as total environmental impact. Moreover, the enhanced selectivity and efficiency lead to a more environmentally friendly method of generating furfural, an essential molecule for many industrial uses such as biofuels, plastics, and pharmaceuticals. In conclusion, a major development in biomass conversion technology has been made with the synthesis of furfural from the dehydration of xylose using nano-catalysis. In addition to demonstrating how well nanostructures catalyze reactions, the work highlights the significance of environmentally responsible and sustainable methods for producing valuable compounds from renewable resources.

**Keywords:** Xylose , Furfural ,Dehydration, Catalysis.

## In An Aqueous Phase, Propylene Glycol is Hydrogenated from Lactic Acid

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### Abstract:

In the realm of sustainable chemistry, the aqueous-phase hydrogenation of lactic acid to propylene glycol is a catalytic process of great importance. Renewable resources provide lactic acid, which is an essential step in the synthesis of propylene glycol, a versatile substance used extensively in food, medicine, and cosmetics. An outline of the main elements of this hydrogenation process is given by the preparation technique, which also highlights the catalytic systems, reaction processes, and methods for process optimization. Under mild conditions, the effectiveness of several catalysts, such as supported metals and bimetallic complexes, is investigated to promote the selective conversion of lactic acid to propylene glycol. In addition to serving as a reaction medium, the aqueous environment is essential for determining the activity and selectivity of the catalyst. Additionally, discusses difficulties arising from the creation of by-products and the deactivation of catalysts, stressing the significance of comprehending the fundamental chemistry to enhance processes. Ultimately, a realistic and sustainable method for producing a valuable chemical intermediate at a reasonable cost is the aqueous-phase hydrogenation of lactic acid to propylene glycol.

**Keywords:** Aqueous-phase hydrogenation, Lactic acid, Propylene glycol, Economically viable

## **A Comparative Study of Physical and Chemical Modifications for Selective Adsorption of CO<sub>2</sub> for Biogas Purification**

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### **Abstract:**

Biogas, a promising bioenergy source rich in methane (CH<sub>4</sub>), remains underutilized due to its significant carbon dioxide (CO<sub>2</sub>) content. Bio-methanation via selectively removing CO<sub>2</sub> from biogas to increase CH<sub>4</sub> concentration, holds immense potential in the carbon neutral energy systems. Among various techniques, the adsorptive separation stands out for its efficiency and simplicity. In this study, the efficacy of Montmorillonite (MMT) as an adsorbent for selective removal of carbon dioxide (CO<sub>2</sub>) from biogas is investigated through two modification methods: physical treatment via ball milling and chemical impregnations with CTAB and H<sub>2</sub>O<sub>2</sub>. The structural changes (surface area and pore-volume) in MMT after physical and chemical modification were investigated with N<sub>2</sub> adsorption-desorption isotherm analysis. FTIR analysis of samples confirmed the successful impregnation of CTAB and H<sub>2</sub>O<sub>2</sub> in the chemically modified samples. The effect of both the modifications on the adsorption properties of samples was investigated with high-pressure (10 bar) adsorption measurement experiments. These experiments show higher CO<sub>2</sub> uptake in chemically (CTAB and H<sub>2</sub>O<sub>2</sub>) modified samples as compared to ball milled samples. The CO<sub>2</sub> adsorption capacity of ball milled sample is similar to the original material. The adsorption isotherm data on prepared material was applied to Ideal Adsorbed Solution Theory (IAST) model for estimation of adsorption selectivity for CO<sub>2</sub>/CH<sub>4</sub>, CO<sub>2</sub>/N<sub>2</sub>, and CH<sub>4</sub>/N<sub>2</sub>. The MMT sample modified with H<sub>2</sub>O<sub>2</sub>, indicated an increase in CO<sub>2</sub>/CH<sub>4</sub>, CO<sub>2</sub>/N<sub>2</sub>, due to increase in (-Si-OH) active sites in modified samples. The findings of this work highlight the MMT potential for CO<sub>2</sub> removal from biogas, with H<sub>2</sub>O<sub>2</sub> modification. This approach emerges as an effective method for enhancing adsorption selectivity and uptake, contributing to advancements in bio-methanation technologies for maximizing biogas utilization.

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**Keywords:** Adsorption, Ball Milling, Selectivity, IAST, Biogas, Hydrogen Peroxide

## Preparation and Spectroscopic Analyses of Heteroleptic tris- $\beta$ -diketonato Dy(III) complexes for Displays

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### Abstract:

A series of four octa-coordinated, anhydrous in nature luminous complexes have been synthesized and characterized by different spectroscopic techniques such as FTIR, proton NMR, UV-visible and photoluminescence. Dysprosium ion is chelated with –O atoms of three bidentate  $\beta$ -diketone *i.e.* DBM and –N atoms of one bidentate neutral ligand that is derivatives of 2,2'-bipyridine. Proton NMR spectra of synthesized complexes revealed that the protons of  $\beta$ -diketone and –N donor ligands are shifted in opposite direction due to paramagnetic character of Dy(III) ion. Photophysical and electrochemical characteristics of synthesized complexes were studied by absorption, photoluminescence and cyclic voltammetry techniques. The PL spectra of dysprosium ion generate its characteristic yellow emission due to the hyper intense transition ( $^4F_{9/2} \rightarrow ^6H_{13/2}$ ) which is sensitive to the bonding environment of Dy(III) ion. The optical band gap, electronic band gap and yellow emission due to Dy(III) ion confirms the effectiveness of these complexes in display devices.

**Keywords:** Dy(III) complex; Photoluminescence; Paramagnetic  $^1H$  NMR; Tauc's relation; Cyclic Voltammetry.

## Crystal Structure and Optical Response of Green Emissive Tb<sup>3+</sup> Activated GdSr<sub>2</sub>AlO<sub>5</sub> phosphors for Optical Displays

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### Abstract:

Single phasic cool green light emitting Tb<sup>3+</sup> activated GdSr<sub>2</sub>AlO<sub>5</sub> phosphors have been synthesized *via* gel-combustion method. X-ray diffraction, transmission electron microscopy, photoluminescence and CIE color coordinates have been employed to characterize fabricated materials. Diffraction exploration confirms tetragonal crystal formation with space group of I4/mcm. TEM micrograph confirms the nano sized of the particles. The estimated energy gap of undoped and optimized sample is found to be 4.94 and 5.59 eV respectively. The occurrence of efficient energy transfer between Gd<sup>3+</sup> and Tb<sup>3+</sup> results an additional strongest excitation band at 273 nm which resembles to <sup>8</sup>S<sub>7/2</sub>→<sup>6</sup>I<sub>11/2</sub> f-f transition of Gd<sup>3+</sup> ion. The PL spectra of GdSr<sub>2</sub>AlO<sub>5</sub>:Tb<sup>3+</sup> nanophosphors are governed by <sup>5</sup>D<sub>4</sub>→<sup>7</sup>F<sub>J</sub> (J = 3, 4, 5, 6) transitions of trivalent terbium ions in materials and most strong band is recorded at 548 nm with <sup>5</sup>D<sub>4</sub>→<sup>7</sup>F<sub>5</sub> transition which answerable for the green color of synthesized materials. Colorimetric investigation of Gd<sub>1-x</sub>Sr<sub>2</sub>AlO<sub>5</sub>:xTb<sup>3+</sup> (x = 1-7 mol %) nanophosphors significantly suggest the utilization of focused work in optical displays

## Study on the Conversion of Tung Oil Into Biodiesel: Optimization Using Response Surface Methodology

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### Abstract:

The diminishing supply of conventional fuels has pivoted the industry towards adopting sustainable, renewable, and readily available fuels. The conversion of triglycerides or vegetable oil to mono alkyl esters (bio-diesel) became a viable alternative to diesel fuel. Tung oil, or *Vernicia Fordii*, is a plant native to China and South America and is cultivated in parts of the northern provinces of India. It has a unique fatty acid composition containing >80%  $\alpha$ -Eleostearic acid (C18:3) and a degree of unsaturation > 150, giving the oil its special drying property. Alkaline transesterification was used to synthesize biodiesel from this feed, as it had an acid value of 1.68 mg KOH/g, using a Choline Acetate ionic liquid as a catalyst. The greener catalyst was synthesized via a two-step reaction with more than 98.5% yield, possessing a pH of 10.8, and was characterized using FT-IR and <sup>1</sup>H-NMR. The reaction parameters were optimized using response surface methodology combined with central-composite design experiments, which showed that the catalyst dosage was the governing parameter. The obtained biodiesel met the standards of BIS 15607 and ASTM D6751 with Density, 0.9 g/cm<sup>3</sup>, Kinematic viscosity at 40 °C, 4.2 cSt, Acid value, 0.257 mg KOH/g, Cloud point, -3 °C, Pour point, -6 °C, Flash point, 120 °C, and Total sulfur, 3.1 ppm. The reusability of an ionic liquid was assessed three times before its decomposition and degradation, highlighting the green behavior of the catalyst.

## **Development of Emulsifiers for Indian Heavy Crude Oil Using A Novel Surfactant for Pipeline Transportation**

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### **Abstract:**

The development of emulsifiers to form the heavy crude oil emulsion with water is a matter of great concern due to their economic importance for transportation through offshore pipelines. The flow characteristics of crude oil via pipelines are greatly enhanced by using suitable emulsions. In this work, a surfactant's efficacy as an emulsifier for creating oil-in-water (o/w) emulsion is assessed on Indian heavy crude oil. Heavy crude oil was physiochemically characterized for wax appearance, temperature, wax content, and carbon distribution. It was also analyzed on FT-IR and  $^{13}\text{C}$  NMR. An ultrasonicator was utilized to disperse the heavy crude oil in water, with the doping of the 1% surfactant in the optimized concentration of 50 wt% oil in water. Rheological studies for the measurement of viscosity parameters were performed using a dynamic shear rheometer for both heavy crude and prepared emulsions at a minimum instrument inertia of  $36.86 \mu\text{Nm}^2$ . The prepared emulsions were also characterized for pour point, stability, droplet size distribution, and zeta potential. A significant decrease in both the viscosity and pour point of the prepared crude oil emulsion were observed. Most of the prepared emulsions had a pour point of less than  $3^\circ\text{C}$ . The effects of aqueous-phase salinity and pH on the emulsion properties were also studied to minimize the amount of surfactant required. Although an increase in water pH  $\sim 10$  helped to achieve better flow ability and stability of the emulsions. An increase in water salinity showed no significant positive effect on emulsion properties. The proposed studies suggest that the synthesized surfactant may be used to prepare stable o/w emulsions with 50 wt% oil and 1 wt% surfactant to the total emulsion to transport the heavy crude oil through pipelines efficiently.

Keywords: Heavy crude oil; surfactant; emulsion; rheology.

## **Development of “All Weather Grade” Diesel Fuel for High Altitude Areas**

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### **Abstract:**

In cold regions, the paraffins present in diesel have the tendency to separate out as wax which causes flowability issue of diesel. These wax crystals tend to block the diesel fuel filter and prevent engine operation at temperatures below the fuel cloud point. Hence, normal diesel usage becomes unsuitable for the vehicle engines to be operated at low temperatures at higher altitudes. Motorists in high-altitude areas face the problem of freezing of diesel in their vehicles when winter temperatures drop to as low as -30 oC. So, cold flow properties viz. pour point, cloud point, cold filter plugging point (CFPP) etc of diesel fuel are extremely important parameters and need to be sufficiently low.

In order to resolve the engine operability issues faced by people living at higher altitudes, a feasibility study has been conducted to develop winter grade diesel with combination of suitable refinery streams complying with winter grade diesel specifications. Further, it is renamed as “All Weather Grade” diesel (AWG-HSD). The developed product has excellent cold flow properties viz. low cloud point, pour point and CFPP without using any cold flow additive. The newly developed AWG-HSD is an environmentally friendly product with sulfur content less than 10 ppm. Product performance evaluation was conducted for its cold startability & drivability on the test vehicle and fuel was found passing in both the test. Details of the study and results will be discussed in technical paper.

**Key words:** cold flow properties, high altitude, winter grade diesel

Paper ID: IAC-24-37

### **Aerobic Oxidation of Vanillyl Alcohol to Vanillin over CeO<sub>2</sub>-Co<sub>3</sub>O<sub>4</sub> Catalyst**

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#### **Abstract:**

A new CeO<sub>2</sub>-Co<sub>3</sub>O<sub>4</sub> mixed oxide catalyst, prepared in a 9:1 mole ratio, was investigated for aerobic oxidation of vanillyl alcohol to vanillin. To heighten its efficacy, the catalyst underwent various preparation methods, including template-assisted synthesis, coprecipitation with and without surfactant, wet-impregnation, and solution combustion. The prepared catalysts were characterized by XRD, Raman spectroscopy, BET surface area analysis, ICP-OES, FE-SEM, HRTEM, H<sub>2</sub>-TPR, and XPS. Among these, the template-assisted synthesized catalyst demonstrated remarkable activity, achieving 100% conversion and selectivity alongside notable stability. This superior performance was attributed to reduced crystallite size, a high specific surface area (92 m<sup>2</sup>/g), increased surface oxygen, and enhanced redox behaviour, as evidenced by XRD, BET surface area, XPS, and H<sub>2</sub>-TPR analyses, respectively. The catalyst stability was evaluated through reusability tests, showing a minimal decrease in catalytic activity over five cycles. Additionally, optimization of catalytic activity was pursued by varying reaction parameters such as time, solvent, temperature, and catalyst weight.

**Evaluation of Heavy Metals in North Gujarat Crude & their Effects in Treated Refinery Effluent Water**

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**Abstract:**

North Gujarat Crude oil extracted from oil fields of Gujarat, India have a considerable amount of heavy metals such as cadmium, nickel, zinc, manganese, vanadium, copper, chromium, lead, arsenic and mercury etc. as part of the impurities present. Some of the dominant methods of metal removal from crude oil include: deasphalting, hydrocracking and hydrotreating. Other methods under investigation include; oxidation, adsorption, acid attack, solvent extraction etc. The presence of metals in crude oil during subsequent processing may cause corrosion, environmental pollution, and may poison the catalysts used in the secondary units. The metals may also interfere in oil refining processes by causing excessive coke formation. Operations and waste products associated with metal extraction and processing are the principal causes of environmental concerns about metal mining. Concerns include: Physical disturbances to the landscape. Soil and water contamination. These toxic discharges which are the heavy metals and other trace elements can be uncontrollably percolated and penetrated to the industrial effluent. Heavy metal-contaminated water is the threat for living organisms as well as to the environment that instigates climate change. These heavy metals need to be removed from the industrial effluent using cost- effective efficient adsorbents before discharging it to the rivers. This study provides an insights into the evaluation of heavy metals contribution in Treated Industrial Effluent Water because of North Gujarat crude.

**Keywords:** Hydro treating: Removal of sulfur and other impurities; Industrial Effluent Water: Discharge from various industries.

## High-Performance Liquid Chromatography-Based New Developed Test Methods for Petroleum Applications

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### Abstract:

India is the third-largest crude oil importer, with around 80% of its crude requirements met through imports. It follows strict quality control using standard test methods involving physicochemical, gravimetry, volumetry, electro-analytical, chromatography, and spectroscopy techniques. Chromatography-based test methods significantly facilitate petroleum product characterization through various approaches. High-performance liquid chromatography (HPLC) is a versatile, precise, and sensitive analytical approach to petroleum characterization. It is a popular technique for petroleum fuel characterization and is highly useful in the development of products. The development of new HPLC methods is still gaining momentum due to the short analysis time, inexpensive nature, and advantages over other chromatographic techniques (elution/column and gas). We developed HPLC-based new methods with the intention to carry out chemical characterization and quality control of various petroleum products and contemporary alternative fuels. The following methods present the adopted HPLC approach in determining the composition of various fuel blends and automotive lubricants:

**Biodiesel in Diesel:** This method is applicable for determining FAME content in biodiesel-blended automotive diesel/paraffinic diesel fuels contaminated with non-esterified vegetable oils. The method overcomes the limitations of ASTM D7371, and its significant advantage is its extended and superior range for FAME determination, i.e., 0.1 to 50 volume %, which is ten times below and 2.5 times above the lower and upper quantification limits. The method validation was carried out by analyzing certified and real biodiesel-blended automotive diesel/paraffinic diesel fuels.

**Total aromatics and additives in fresh and used lubricating oils:** This method is applicable for determining total aromatics and polar/additives in fresh and used lubricating oils. The method reported high precision, low LOD, and LOQ, and a linear response range of 0.1 to 30% for total aromatics and 0.1 to 20% for additives. The relative standard deviations for aromatics and additives in fresh and used lubricating oils were 0.50-6.00% and 3.00-7.00%, respectively. The method validation was carried out by analyzing commercial fresh and used lubricating oils.

**Advancement in The Analytical Techniques For COVID-19 Detection and the Development of QNMR Method for The Quantitative Analysis of API In The Formulation Available in the Market for its Cure**

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**Abstract:**

The world has been fighting deadly COVID-19 since December 2019. This highly contagious disease is caused by the transmission of a virus called SARS-CoV-2, which supposedly has a zoonotic origin from bats. Analytical chemistry is a field that incorporates qualitative and quantitative analysis of analytes. Analytical chemistry plays a significant role in every domain of life including agricultural, environmental, clinical, forensic, pharmaceutical, manufacturing, and metallurgy. But its utility during the COVID-19 pandemic proves its utmost significance in the field of bio-analysis. Different testing techniques have been utilized depending on the availability of the required chemicals and the laboratories. The availability of SARS-CoV-2 viruses' genetic information had a significant impact in the development of detection techniques. At present, numerous diagnostic analyses have been employed in clinical research. This paper shows major analytical techniques that are currently available for COVID-19 diagnosis. A discussion on most of the widely used analytical methods for COVID-19 diagnosis and their sensitivity, specificity, benefits, and drawbacks is presented.

NMR (Nuclear Magnetic Resonance Spectroscopy) primarily is considered as a qualitative analytical tool. The qNMR relies on the direct proportionality of integrated analyte signals with the number of resonant nuclei that offers the advantages in chemical, pharmaceutical and medicinal analysis purposes. This is a rapid, non-destructive nature technique which involves minimum sample preparation. In the pharmaceutical domain, qNMR applies in the identification and quantification of API's.

**Keywords:** COVID-19, Analytical Techniques, qNMR, Pharmaceutical Industry, Medicinal Domain

## **Biomimetic CO<sub>2</sub>-Phillic Enzymes for CO<sub>2</sub> Sequestration And Utilization Into Value-Added Products**

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### **Abstract:**

Continuous economic growth, development, sustainability and agricultural advancement, causes higher energy consumption and CO<sub>2</sub> emissions which ultimately leads to major global climate change and poses incomparable threats to our environment. To address such problems, one cannot simply stop the wheels of development like industry, automobiles, power plants, and modern agriculture. So, CO<sub>2</sub> capture and sequestration (CCS) and CO<sub>2</sub> capture and utilization (CCU) are promising alternatives to mitigate CO<sub>2</sub> emissions or “recycling of CO<sub>2</sub>” into value-added products. Enzymatic reduction of carbon dioxide (CO<sub>2</sub>) to methanol (CH<sub>3</sub>OH) can be accomplished by an efficient multi-enzyme cascade system (MECS) using a designed set-up of three oxidoreductases namely Formaldehyde dehydrogenase, formate dehydrogenase and alcohol dehydrogenase with reduced pyridine nucleotide (NADH) as cofactor for the reducing equivalents electron supply. In the present study, bacterial strains were isolated from the hot water spring of Himachal Pradesh, India using the enrichment culture technique. After thorough screening for enzyme activity in the bacterial cultures, four isolates were selected. These strains have been identified based on physiological and molecular characteristics and four different enzymes namely Formate dehydrogenase (FDH) from *Bacillus paralicheniformis*\_SN1 having Accession No- PP217769, Formaldehyde dehydrogenase (F<sub>al</sub>DH) from *Bacillus licheniformis*\_SN2 having Accession No- PP217770, Alcohol dehydrogenase (ADH) from *Bacillus licheniformis*\_SN3 having Accession No- PP217771 and Carbonic anhydrase (CA) from *Bacillus tequilensis*\_SN4 having Accession No- PP217772 have been partially purified with Calculated enzyme activity 0.64mg/ml, 1.66mg/ml, 1.34mg/ml respectively. The enzymes were partially purified from a cell extract by 30-65% ammonium sulfate fractionations and used for CO<sub>2</sub> conversion into Methanol and Calcium Carbonate. The study presented here is one of the efforts of using enzymes as a means for CO<sub>2</sub> conversion and to reveal the new possibilities to encourage them as efficient innovative pathways of technologies in the field of CO<sub>2</sub> management.

## **Determination of Used Cooking Oil and Waste Hydrocarbon Solvents in Biodiesel Fuel Through High-Performance Liquid Chromatography**

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### **Abstract:**

Biodiesel is a promising green fuel that is perceived as a suitable replacement for petroleum fuels. It is free of sulfur and aromatic hydrocarbons, emits lower greenhouse gases upon combustion, and is derived from renewable sources. Biodiesel is a mono-alkyl ester derived primarily from non-vegetable oil, used cooking oil, animal fats, algae, etc. Due to the depletion of petroleum resources and the harmful effects of toxic gases generated by engines running on petroleum fuel, biodiesel is becoming popular as an alternative fuel. Besides, the increasing cost of crude oil has necessitated the development of alternative fuels. Any alternative energy must be economically appealing, technically feasible, and clean to compete with currently used fossil fuels. The national biofuel policy targets to achieve 5% blending biodiesel in petrodiesel by 2030. The growing demand for biodiesel has also given rise to the malpractice of adulteration. Raw vegetable oils used cooking oil, and waste hydrocarbon solvents are potential adulterants for biodiesel adulteration. Determination of used cooking oil and hydrocarbon solvents in the finished biodiesel is not possible with existing chromatography methods; hence, their development is significant from the perspectives of environment and automotive engine issues. The proposed method is simple, fast (runtime of 12 min), and does not require sample pre-treatment. It exhibits high precision and superior limits of detection and quantification and efficiently differentiates between biodiesel and its contaminants.

The method demonstrated good linear response ranging from 0.1 to 20 % mass for raw vegetable oils or used cooking oil and 0.1 to 20 (mass%) for hydrocarbon solvents. This normal phase HPLC method involves refractive index detection to achieve the best response of analytes and a silica column to obtain optimum separation between hydrocarbon solvents, fatty acid methyl esters (biodiesel), and triglycerides (raw vegetable oils and used cooking oils). n-Hexane was used as the mobile phase, with isopropanol mobile phase modifier. Measurement of all analytes exhibited high precision and low limits of detection and quantification. It shows that the proposed method is simple and fast, does not require sample pre-treatment, and efficiently differentiates between biodiesel and its contaminants.

## Effects of Acoustical waves and Surface Wetting Characteristics on Phytochemical production of medicinal plant *Gentiana kurroo*

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### Abstract:

***Gentiana kurroo*** (*trayamana*) is known for its medicinal properties and therapeutic uses. The plant shows effective results in cases of cancer, leprosy, hepatotoxicity, and diabetes. With the help of the frequency modulator, plant acoustic frequency technique (PAFT), the amount of phytochemical content can be increased by giving plants some fixed sound waves, i.e., three frequencies (500hz, 1Khz, and 1.5Khz) considering them as test samples. Another instrument, a tensiometer, can be used to assess the leaf's surface wetting ability. Optical tensiometer used for the surface wetting characteristics specifically how water interacts with the surface of medicinal plants. The use of acoustical setups has the potential to influence surface wetting characteristics as well as some other important aspects of plant growth, such as enhanced nutrients and water uptake, optimization of cell growth and metabolism, stress reduction and adaptation, and some more secondary metabolite production. Surfactants like Tween-20 (non-ionic), SDS (anionic), and CTAB (cationic) are used. Solvents such as dilute HCl, acetone, and water are used. They are very important for measuring how well surfaces stick to each other because they can change the surface tension and how liquids stick to solid surfaces, in assessing contact angle, the critical micelle concentration (CMC), how much the liquid can penetrate and spread, the surface energy, and more. The tissue-cultured **G. kurroo** plant extract is prepared as control samples (under normal conditions) and test samples (under acoustical conditions) and undergoes physico-chemical characterization by considering parameters such as density, viscosity, surface tension, and velocity. These parameters aid in the identification of active compounds, quality control and standardisation, extraction method optimization, formulation and product development, pharmacokinetics, and so on.

**Keywords:** ***Gentiana kurroo***; plant acoustic frequency technique; tensiometer; contact angle; surface free energy; surfactants.

## **CO<sub>2</sub>-Steam Bi-Reforming of Methane Over La<sub>1-x</sub>Sr<sub>x</sub>Ni<sub>0.8</sub>Zr<sub>0.2</sub>O<sub>3</sub> Perovskite Catalysts to Generate Hydrogen-Rich Syngas**

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### **Abstract:**

Methane and carbon dioxide are two potent greenhouse gases and emissions of these gases are increasing rapidly. In recent times researchers showed interest on these compounds either to reduce or convert them into useful products. Combined reaction of these two major greenhouse gases is studied in the name of dry reforming and bi-reforming of methane. Dry reforming has its own importance in terms of energy and climate change as well as production of high valuable product called syngas. The syngas is a mixture of hydrogen and carbon monoxide. It has huge applications in synthesis of fine chemicals, ammonia, methanol, and Fischer-Tropsch reaction. bi-reforming of methane (BRM) is one of the best routes to alter the syngas ratio by varying the steam to carbon ratio. It is reported that the production of syngas (H<sub>2</sub>/CO=2) using bi-reforming of methane is more suitable for methanol synthesis, as it eliminates the need of extra hydrogen addition from external sources.

The present study proposes La and Sr-containing La<sub>1-x</sub>Sr<sub>x</sub>Ni<sub>0.8</sub>Zr<sub>0.2</sub>O<sub>3</sub> (x=0.1, 0.2, 0.4, 0.6, 0.8) perovskites as potential catalysts for bi-reforming of methane (BRM) with CO<sub>2</sub> and steam to produce hydrogen-rich syngas. The catalysts were prepared by sol-gel method and characterized using various techniques such as XRD, H<sub>2</sub>-TPR, BET, CO<sub>2</sub>-TPD and CHNS analysis. The characterization studies revealed that metal-support interaction increased with the increase in the composition of Sr and the reduction behavior of Ni found to vary with the addition of Sr. The CO<sub>2</sub>-TPD results suggest that a small amount of Sr can change the basicity of the support. The BRM activity results revealed that La<sub>0.8</sub>Sr<sub>0.2</sub>Ni<sub>0.8</sub>Zr<sub>0.2</sub>O<sub>3</sub> perovskite is the most promising and active catalyst. The proposed catalysts are found to be advantageous w.r.t less carbon deposition due to the increased dispersion, small crystalline size, and required basicity of the support. The catalyst has shown excellent stability for a studied period of 100 h.

## Green Functionalization of Chitosan for Advanced Material Applications

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### **Abstract:**

Chitosan, derived from chitin, is the second most abundant polysaccharide on Earth, extracted at low-cost from crustacean shells and insects. It features amino and hydroxyl groups in its glucosamine units, making it useful in a variety of fields including drug delivery, biotechnology, food technology, and environmental protection. However, its application is often limited by poor solubility in environments with a pH above 6.5, prompting research into chemical modifications that can enhance its solubility under neutral and basic conditions.

Among these modifications, quaternary chitosan derivatives stand out as a significant class of water-soluble chitosan forms, suitable for expanded uses in water treatment and biomedicine. Traditional methods for synthesizing quaternary chitosan typically use harmful reagents, such as the carcinogenic epichlorohydrin and glycidyl trimethylammonium chloride. This study proposes an alternative approach using the environmentally friendly reagent choline chloride. Analytical techniques including titrimetric estimation, FTIR, NMR, and elemental analysis have been employed to verify the functionalization process. Titrimetric estimation indicates a chloride content of approximately 10%, suggesting a modification degree of around one. These findings are further confirmed by other characterization techniques. The resulting quaternary chitosan holds promise not only as an antimicrobial agent but also as an eco-friendly flocculent for treating various pollutants in wastewater.

**Keywords:** Polysaccharide, Chitosan, Quaternary chitosan, choline chloride

# Synthesis and Characterization of 4-((Substituted-3-Aryl-1,8-Naphthyridin-2-Yl)Amino)Phenol Derivatives: Antimicrobial and in Vitro Cytotoxic Activity Evaluation Studies

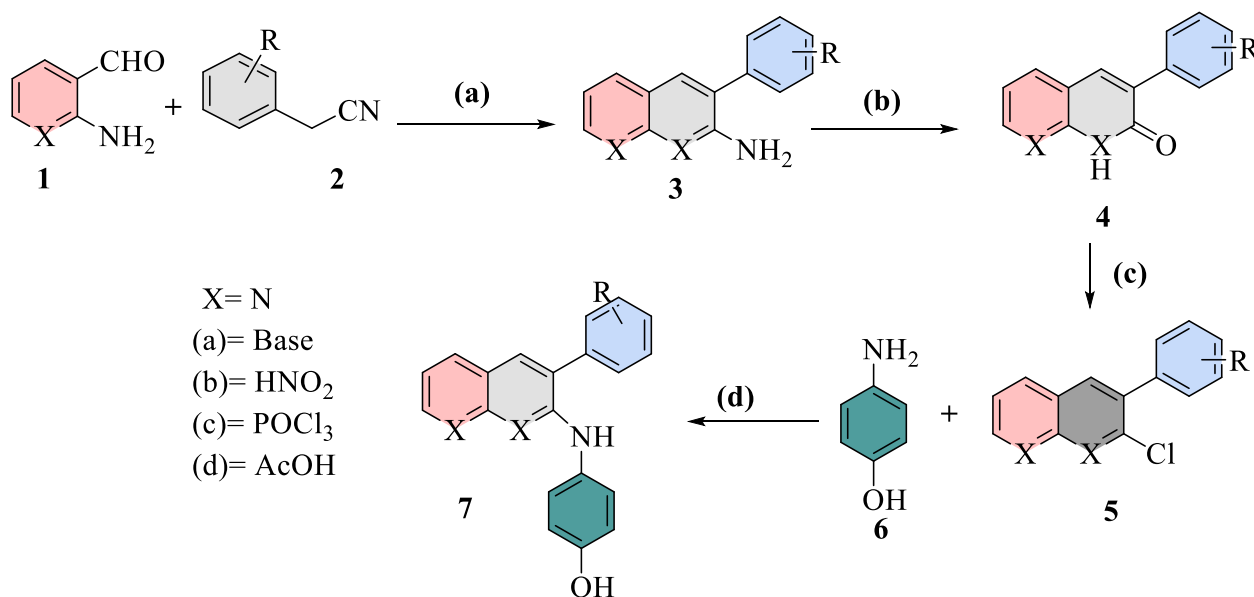
Boda Sakram and Ergurala Naveen

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## Abstract:

1,8-naphthyridines have emerged as important heterocycles, 1,8-Naphthyridine scaffold is a nitrogen-containing heterocyclic compound known for its versatile biological activities. 1,8-naphthyridine group of products have gained special concentration of researchers on account of their demonstrating a wide variety of biological activities for example antifungal, anti-inflammatory, good HIV-1 integrase inhibitor profiles, antimalarial, and cytotoxicity [1-3]. Using 2-aminonicotinaldehyde as a starting material with a variety of substituted aryl acetonitrile's formed compound 3-(2-chloro-6-fluoro-aryl)-1,8-naphthyridin-2-amine **3**, then it reacted with  $\text{HNO}_2$  formed compound **4** then it reacted with  $\text{POCl}_3$  obtained 2-chloro-3-aryl-1,8-naphthyridine (**5**) with in the presence of glacial acetic acid and ethanol afforded desired products 4-((3-aryl-1,8-naphthyridin-2-yl)amino)phenol scaffolds. All the synthesized molecules shown good biological activity.



**Synthesis of Heterocyclic–Fatty Acid Hybrid Derivatives of 2(1, 3-Dioxoisindolin-2-Yl) Ethyl Fatty Ester, Biological Evaluation and Their Molecular Docking Studies**

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**Abstract:**

The isoindoline scaffolds and their related compounds are the interesting core structures for the development of bioactive compounds. Fatty acids derived from renewable raw materials exhibit various biological activities. The combination of these two bioactive compounds can synthesize bioactive hybrid molecules with some desirable features. Heterocyclic-fatty acid hybrid derivatives are a new class of heterocyclic compounds with biological activities and significance in the field of medicinal chemistry. A series of 2(1, 3-dioxoisindolin-2-yl) ethyl fatty ester were designed and synthesized in an efficient method by involving Phthalic anhydride using O-Xylene and 2-Amino ethanol to give 2-(2-hydroxy ethyl)-1H-isoindole-1,3-(2H)-dione. This compound was esterified with various long chain fatty acids using catalyst in DCM at 40<sup>o</sup> C. Structural establishment of the target compounds were confirmed based on the IR, <sup>1</sup>H, <sup>13</sup>C NMR and Mass spectral analysis.

## **A Facile Synthesis of Murrayakoenigii /Znocomposite for Removal of Wastewater Contaminants from Aqueous Environments**

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### **Abstract:**

Biowaste to valuable adsorbent conversion is an effective strategy for mitigating environmental stress. Biochar is a porous, carbonaceous substance that is typically produced by pyrolyzing biomass in an oxygen-depleted environment. It is characterized by its substantial water-holding capacity, a multitude of functional groups, and high surface area, in addition to its high porosity and exhibits favorable adsorption capabilities for organic dyes, heavy metals, and pharmaceuticals on account of these characteristics. Herein we have synthesized Murrayakoenigii /ZnO composite. The enhancement of biochar's surface morphology and properties can be achieved by incorporating nanometal oxides. Hybrid composites composed of biochar and metal oxides exhibit remarkable physiochemical properties and a wide range of functionalities which are utilized by scientists in diverse fields as adsorbents, sensors, and electrical storage devices, photocatalyst

**keywords:** Biowaste, Biochar, metal oxide nanoparticles, adsorbent, photocatalyst.



## Development of Ordered Mesoporous Carbon Nanocomposites for Dye Sequestration

Anjali Bhardwaj and Ashok K Sharma

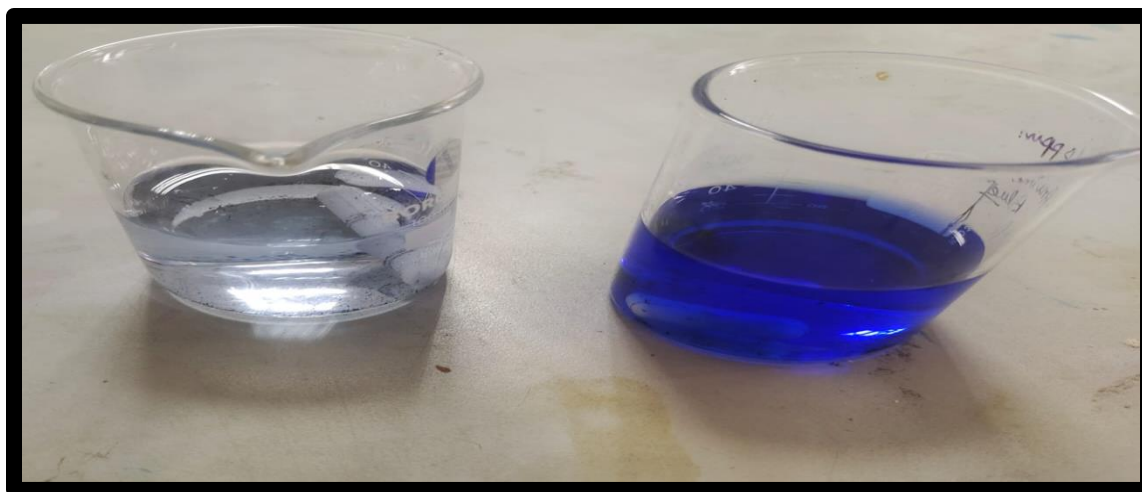
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### Abstract

Now a days, the **mesoporous carbon materials** are highly promising material. Numerous synthetic techniques viz. hydrothermal, co-precipitation, green synthesis routes are used to synthesize the mesoporous carbon materials that can modify material properties including specific surface area, pore volume, pore size or shape. We have synthesized Cu and Ni doped mesoporous carbon (CNC) using soft template method. Physicochemical analysis using various techniques were performed to characterize the synthesized material. Experiment results indicated that fabricated material can efficiently removed aniline blue dye from its aqueous solution. The adsorption experiments were carried out by using batch-mode procedure involving the determination of pH effect, adsorbent concentration and contact time. Furthermore, the rate of adsorption was successfully analyzed by using various isotherms.

**Keywords:** Mesoporous carbon, hydrothermal method, Aniline Blue, Adsorption.



## **Metal Oxide-Infused Chitosan Polypyrrole Matrix-Modified Glass Rod as a Sensor for the Electrochemical Detection of Chlorpyrifos**

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### **Abstract:**

**Introduction:** The large use of Chlorpyrifos (CPY), an organophosphate pesticide to fulfill the food demand has led to the problem of pesticide pollution. Thus, the development of a CPY sensor is crucial for field-based on-site testing as well as typical laboratory testing of soil, water, vegetables, and fruits. The present work aims to demonstrate a potentiometric sensing of residual CPY by modifying a chitosan polypyrrole matrix infused with copper oxide on a glass rod under optimized conditions. The structure, morphology, and physical characteristics of the created composite were examined using Fourier transform infrared, Raman, X-ray diffraction, scanning electron microscopy, and other relevant standard methods. With synergism between the structural design and molecular engineering of the composite, the developed sensor exhibits great stability, high electrical conductivity, porous nature, responsiveness, and better response time. Furthermore, the developed lab-built glass rod sensor was investigated for residual CPY sensing in natural and synthetic samples of apples, and broccoli. At ambient temperature (25 °C) and neutral pH (7.0), the sensor showed a larger sensing range of 1.0–100.0  $\mu\text{M}$  with an increased sensitivity of  $2.48 \text{ mV}\mu\text{M}^{-1}\text{cm}^{-2}$ , detection limit of  $0.75 \mu\text{M}$ , response time of 80 s, recovery time of 10 s, and stability of 70 days. Furthermore, the structural modifications resulting from the surface interaction of electrode material with CPY and the formation of induced electrode potential have been investigated concerning the sensing process.

**Keywords:** CPY Sensing, Potentiometry, In-situ polymerization, MO-in-CHIT-PPy

**Mesoporous Ceria–Supported Vanadia Catalyst for Selective Aerobic Oxidation of Ethylbenzene**

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**Abstract:**

A series of mesoporous ceria–supported vanadium oxide catalysts were prepared, and explored for aerobic oxidation of ethylbenzene to acetophenone without the involvement of any solvent or additives. Catalysts with varying content of  $V_2O_5$  (3, 6, and 10 wt%) on mesoporous  $CeO_2$  support were prepared by wet-impregnation method. Catalysts were characterized using techniques namely, XRD, Raman, BET surface area, ICP-OES, FE-SEM, HR-TEM, XPS, and  $H_2$ -TPR to establish correlations between the physicochemical properties and catalytic performance. Among the investigated catalysts, the 6 wt.% of  $V_2O_5$  on mesoporous ceria showed better activity with 69% ethylbenzene conversion and 88% acetophenone selectivity. The superior activity of this catalyst was ascribed to a strong synergetic interaction between ceria and vanadia as well as the formation of  $CeVO_4$  phase, and a high specific surface area. The reaction parameters like temperature, pressure, and the amount of catalyst were optimized for possible commercial utilization. The stability of the catalyst was also investigated by reusability test and found to be stable and active for up to five cycles.

**Sm<sup>3+</sup>–Activated Gd<sub>3</sub>Al<sub>5</sub>O<sub>12</sub>Phosphor: Structural and Photophysical Insights for Advanced Lighting Applications**

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**Abstract:**

In this study, we report the synthesis of reddish-orange emitting Gd<sub>3</sub>Al<sub>5</sub>O<sub>12</sub>:Sm<sup>3+</sup> phosphors using an efficient, economical and time-saving urea-assisted gel-combustion method. Comprehensive structural and optical characterizations were conducted to analyze the synthesized samples. Crystallographic studies revealed a cubic crystal system with the space group Ia- $\bar{3}d$  (230). Morphological analysis indicated the presence of non-uniform agglomerated spherical particles in the nano-range. Under excitation at 276 nm, emission spectra exhibited three broadband peaks centered at 566, 602 and 652 nm, corresponding to transitions  $^4G_{5/2} \rightarrow ^6H_J$  ( $J = 5/2$  to  $9/2$ ). Concentration quenching was attributed to dipole-quadrupole interactions between neighboring trivalent samarium ions. The optimized sample ( $x = 0.03$ ) demonstrated promising luminous performance, as evidenced by CIE chroma coordinates (0.574, 0.390), a color temperature value of 1713.66 K and high color purity (89.78%). These results underscore the potential of the synthesized nanophosphors for advanced lighting applications.

**Fluorinated B-Diketonate Eu(III) Complexes Based On 2,2'-Bipyridine as Red Emitter for Display Applications**

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**Abstract:**

In this present work, synthesis of four europium (III) complexes utilizing fluorinated  $\beta$ -diketone chromophoric moiety with auxiliary ligands: 2,2'-bipyridine and derivatives are reported. The structure and bonding characteristics of the synthesized complexes was analyzed by different spectroscopic and analytical techniques such as FTIR, <sup>1</sup>H-NMR and elemental analysis etc. Thermogravimetric analysis was utilized to analyze the thermal stability of complexes. The photoluminescence emission spectra of complexes show the existence of characteristic peaks corresponding to Eu<sup>3+</sup> ion attributed to <sup>5</sup>D<sub>0</sub>→<sup>7</sup>F<sub>J</sub> transitions. PL outcomes and color parameters have specified the red emissive nature of prepared complexes. The optical and electronic band gap values show the semiconducting behavior of complexes. These conducting and luminous complexes might be utilized as red light emitting materials in various display devices.

**Keywords**

Europium complexes; Antenna Effect; Band Gap; Luminescence; Luminescence Lifetime

## Efficient Photocatalytic Degradation of Textile Dye Using Zinc-based Metal-Organic Frameworks: A Sustainable Approach

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### Abstract:

Untreated wastewater from the textile sector is causing significant pollution of the aquatic environment, a problem that must be addressed immediately. Textile dye, especially methylene blue (MB), is one kind of waste produced by the textile industry. Merely 5% of MB is utilized in the dyeing process, with the remaining 95% being disposed of as waste. Various techniques are used for the removal of MB from wastewater from the textile sector, such as electrocoagulation, adsorption, electrochemical, and photocatalytic degradation processes.

Photocatalytic degradation is emerging as a better technique than other approaches because it can convert organic molecules into simpler, environmentally friendly components. Metal-organic frameworks (MOFs) are materials that have great potential to function as photocatalysts. This study presents the synthesis of novel MOFs using the solvothermal method and characterization by various spectroscopy and diffraction techniques. Zinc (II) imidazole-4,5-dicarboxylate is a kind of MOF constructed from 4,5 imidazole dicarboxylic organic ligands and  $Zn^{2+}$  center ions. The synthesized materials were evaluated for methylene blue degradation under visible light. The initial findings showed that the newly developed MOF is an excellent option for MB photocatalytic degradation. The stability of MOF, kinetics, and mechanism of photocatalytic MB degradation are under investigation.

**Keywords:** Metal-Organic Frameworks, Methylene blue, Photocatalytic degradation.

**Further Observations on Rare Species *Contracaecum Otolithi*, Bilqees and Rashid (1982)  
Recovered from the Intestine of *Heteropneustes Fossilis* (Catfish)**

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**Abstract:**

Nematodes of the genus *Contracaecum* Railliet & Henry, 1912 (Anisakidae, Contracaecinae) is distributed worldwide. The taxonomic study of the genus *Contracaecum* is well-known due to several morphological variations in the body. The genus *Contracaecum* is classified on the bases of microscopic morphological characters focuses on the cephalic, buccal, pharyngeal structures, cuticular details, inter labial location of the excretory pore. An investigation was made on the morphological description of parasitic nematode, *Contracaecum otolithi*, Bilqees & Rashid (1982) collected from the intestine of *Heteropneustes fossilis* (Heteropneustidae family) in Muzaffarnagar region. A known species of Nematode parasite belonging to genus *Contracaecum* was isolated during the survey of helminth parasites of freshwater fishes in Muzaffarnagar region. Morphological description of the species is supported by light microscopic drawings and photomicrographs taken by the Motic microscope.

**Keywords:** Nematode; *Contracaecum*; Fish; *Heteropneustes* etc.

**A Quinoline 2-Aldehyde Derived Schiff Base as a 'Turn-On' Fluorescent Molecular Probe for Al<sup>3+</sup> Ions in Aqueous CH<sub>3</sub>CN Solution**

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**Abstract:**

A facile quinoline 2-aldehyde derived Schiff base (6E)-2-((E-2-((quinoline-2-yl) methylene amino)ethylthio)-N-((quinoline-2-yl)methylene)ethanamine (**SQ**) has been designed and synthesized for fluorimetric detection of Al<sup>3+</sup> ions. Probe **SQ** has been characterized by elemental analysis, FT-IR, <sup>1</sup>H/<sup>13</sup>C NMR, UV-visible, and fluorescence spectroscopic techniques. The probe (**SQ**) exhibits high selectivity towards Al<sup>3+</sup> ions in aqueous acetonitrile (CH<sub>3</sub>CN:H<sub>2</sub>O = 4:1; v/v) solution, even in presence of different bio-relevant as well as other competing transition metal ions (e.g., Na<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Al<sup>3+</sup>, Mn<sup>2+</sup>, Fe<sup>2+/3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Cu<sup>2+</sup>, Zn<sup>2+</sup>, Pb<sup>2+</sup>, Cd<sup>2+</sup>, Hg<sup>2+</sup>, etc.). Probe **SQ** acts as a 'turn-on' responsive probe as a remarkable fluorescent enhancement at 422 nm could be realized upon adding 4.0 Equiv. of Al<sup>3+</sup> to **SQ**, respectively, with excitation wavelength at 310 nm. **SQ** could recognize as low as 15.8 nM Al<sup>3+</sup> with a linear response towards these ions over a concentration range of 0-10<sup>-6</sup> M. Interestingly, the addition of Al<sup>3+</sup> resulted in a remarkable blue shift (ca. 20 nm) in the emission and absorption maxima of **SQ** which could be attributed to a strong complexation of Al<sup>3+</sup> to the probe.

**Keywords:** Quinoline 2-aldehyde; Schiff base; Fluorescent probe; Turn-ON; DFT studies.

## Comparative Evaluation of Niobium Mxene-Enhanced Carbon Screen Printed Paper-Based Electrochemical Immunosensor and Piezoelectric Techniques for Point-of-Care Diagnosis of Cardiac Troponin I

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### Abstract:

Acute myocardial infarction (AMI), also referred as "heart attack," is the leading cause of death in developed nations, putting an increasing demand on healthcare facilities. Healthcare monitoring must improve to include a quick, error-free, and conclusive diagnostic method for the early detection of AMI biomarkers. We demonstrated the efficacy of Niobium Mxene (Nb<sub>4</sub>C<sub>3</sub>) for detecting cTnI (Cardiac Troponin I), Through electrochemical and Piezoelectric biosensing. A human cardiac protein biomarker of physiological significance. The detection aims for cost-effectiveness, label-free detection, and a lower mortality rate for therapeutic decisions. In this work, Paper electrodes modified with Nb<sub>4</sub>C<sub>3</sub> sheets were employed for the covalent immobilization of target specific antibody (Anti-cTnI) for electrochemical and piezoelectric detection of cTnI antigen. Different parameters like Anti-cTnI concentration (50ng/mL), pH of the electrolyte used (7.0), and incubation time (80 seconds) were optimized for improved performance of developed immunosensor. The immune sensing platform was further used to check the current response obtained for cTnI antigen concentration i.e. 0.1-80ng/mL and a detection limit of 0.16 ng/mL was obtained. The sensing platform has shown high specificity for its target and a shelf life of 30 days was observed. The combination of developed immune sensing method for shortened detection time, as well as the affordability, suggests a portable system for detecting cTnI even in human serum samples.

**Keywords:** Cardiac Troponin I, Acute Myocardial Infarction, Electrochemical detection, Immunosensor, Reduced graphene oxide, Antibody.

**Cr (III) Metal Complex of Quinoline Derived Schiff Base: Synthesis and Characterization**

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**Abstract:**

An attempt has been made to prepare Schiff ligand(L<sub>1</sub>) using aqueous ethanolic solution of 2-Quinolincarboxaldehyde and phenylhydrazine using conventional method and also the microwave assisted technique. Further, the newly synthesized ligand is allowed for complexation with Chromium chloride with aqueous ethanolic solution of Histidine (L<sub>2</sub>) as secondary ligand. Hence, a ternary complex has been synthesized. Physicochemical data, Elemental Analysis, <sup>1</sup>H NMR spectra and HRMS Spectral data with molar conductance of synthesized ligand/complex are presented for characterisation. Mass spectrum of synthesized complex shows the investigated metal chelates. An octahedral geometry proposed for the synthesized complex. Low conductance supports the non-electrolytic nature of the complex with diamagnetic nature. Based on NMR data, no water molecule coordinated to metal ion was observed. Above compounds are further evaluated for antimicrobial studies against selected bacterial and fungal strains. Results were compared with standard drugs to present the scope of work done.

Keywords: 2-Quinolincarboxaldehyde, Phenylhydrazine , Histidine, Ternary complex, Antimicrobial

**GC-MS Analysis and Antioxidant Activity of Bioactive Compounds Present in Ethanol Extract of Cinnamomum Zeylanicum (Dalchini) Bark**

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**Abstract:**

To investigate and characterize chemical composition and perform phytochemical screening, estimate total phenolic, flavonoids and evaluate antioxidant potential of ethanol extract of Cinnamomum zeylanicum (Dalchini). C.zeyalnicum belongs to the family Lauraceae. C. zeyalnicum is a native of Sri Lanka and southern parts of India. Cinnamon is one of the most appreciated spices for flavoring food products. In the present work was performed with chloroform fraction of the ethanol extract of C. zeylanicum. In present study the ethanol extract of C.zeyalnicum were subjected to GC-MS analysis. Gas chromatography-Mass spectrometry results revealed presence of 20 phytoconstituents in ethanol extract. Plants have a large number of bioactive compounds with high antioxidant activity and presence of many biological important constituents, including heterocyclic compounds, hydrocarbons, long chain aliphatic carboxylic acid and their derivatives, such as esters, hydroxy esters, and aromatic compounds. Ethanol extract was found to contain the highest phenolic content and flavonoids. The main chemical constituents in C.zeyalnicum bark were cinnamic acid, beta-Caryophyllene, thymol, eugenol and coumarin, cinnamaldehyde. It is testified that regularly drinking of C.zeyalnicum tea made from the bark could be beneficial to oxidative stress related illness in humans, as the plant part contains significant antioxidant potential.

## **The Application of Gas Chromatography in Determining Helium in Natural Gas Samples**

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### **Abstract:**

Helium gas is plentiful in space and has formed as a by-product of fusion reactions inside stars. It is relatively rare on Earth and is present at around 5 ppm in the atmosphere. The natural radioactive decay of heavy radioactive elements such as thorium and uranium forms it, after which it gets trapped in natural gas and extracted commercially by a low-temperature separation process. Since this process is non-renewable, its reserves are diminishing, leading to a scarcity of Helium gas. The concentration of Helium after extraction from the ground ranges as high as 4% by volume in the natural gas.

A refinery gas analyzer (GC-RGA) based on the ASTM D7833 method is suitable for the determination of C<sub>1</sub> to C<sub>5</sub>-hydrocarbons and non-hydrocarbon gases (hydrogen, carbon dioxide, oxygen, nitrogen, and carbon monoxide) in gaseous mixtures including natural gas samples. This method is not applicable for determining Helium in natural gas samples. We propose a simple GC-based method for separating all non-hydrocarbons in natural gas samples, including Helium and all hydrocarbons. Furthermore, the method involves identifying and quantitatively determining Helium 50 ppm to 4 % in the natural gas samples. This study is significant in revealing the compositional details of natural gas and overcoming the limitations of ASTM D7833.

**Design, Synthesis and Biological Evaluation of Triazolyl Nucleosides**

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**Abstract:**

The chemically modified nucleoside analogues have been at the cornerstone/keystone of antiviral and anticancer therapy. Unnatural nucleosides can inhibit the growth of cancer cells by interfering with DNA replication, and reduce viral infection by inhibiting HIV reverse transcriptase. Majority of synthesized nucleosides analogues displayed antiviral and anticancer activity. Ribavirin has shown broad-spectrum antiviral properties against a wide range of RNA viruses. Triazole heterocyclic compounds gained special attention of scientific community due to their potential applications as medicinal agents since 1,2,3- and 1,2,4-triazole units which are not present natural products are remarkably stable towards metabolic transformations that allow to utilize them in various drugs. In view of these results of 1,2,3-triazole bearing nucleosides, we synthesized a novel series of triazolyl nucleosides. Anticancer activities of these synthesized nucleosides are under progress.

## Emerging Perovskite-Based Photodetectors for Enhanced Sensing Technologies

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### Abstract:

Perovskite materials have emerged as promising candidates for high-performance photodetectors due to their exceptional optoelectronic properties. In this study, we present a comparative analysis of perovskite photodetectors operating in both the visible and ultraviolet (UV) spectral ranges. We investigate the performance metrics including responsivity, detectivity, response time, and stability of perovskite-based photodetectors fabricated using different device architectures and fabrication techniques. The influence of material composition, film morphology, and device engineering on the photodetection performance is systematically evaluated. We discuss the fundamental principles underlying perovskite materials, their synthesis methods, and the diverse range of device architectures employed for achieving broad-spectrum detection capabilities spanning from ultraviolet (UV) to near-infrared (NIR) wavelengths. Furthermore, we highlight the strategies for enhancing the photodetection performance, including improvements in responsivity, detectivity, response time, and stability. Moreover, the scalability, integration, and potential applications of broad-spectrum perovskite-based photodetectors in fields such as imaging, spectroscopy, communication, and biomedical sensing are discussed. Finally, we outline the future prospects and directions for further advancing the field of perovskite-based photodetection towards practical and commercial applications. Our findings provide valuable insights for the development of next-generation photodetection technologies based on perovskite materials.

**Synthesis, X-ray Crystallography and Biological Assessment of Some Metal Complexes**

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**Abstract:**

Metal complexes containing N,S donor ligands have been synthesized. Reactivity of the complexes have been examined with different bidentate polypyridyl ligands, It reacted with N, N donor ligands in DMF to afford  $[Ru(L)_2(N-N)]$  and  $[Ru(L)_2(N-N')]$  while, its reaction with phosphorus containing ligands in common organic solvents failed to afford suitable products. Synthesized complexes were found air stable and soluble in most of organic solvents. These complexes were further characterized by elemental analyses, spectral, electrochemical studies. The x-ray quality single crystals are grown in DCM/DEE solvent and the complexes have been determined crystallographically. Serum protein protecting activity of some metal complexes has been assessed.

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**Fluid Catalytic Cracking of Glycerol to Acetaldehyde and Acrolein over E-Cat**

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**Abstract:**

Glycerol is a byproduct of the biodiesel industry. Glycerol to chemicals is a growing area of interest due to its potential economic benefits for the first-generation biofuels sector. This study explores the direct use of existing petroleum refinery infrastructure to transform glycerol into valuable chemicals through cracking, hydrogen transfer, and dehydration. The catalyst used was an equilibrium fluid catalytic catalyst (E-Cat), and the apparatus was cracking evaluation, FCC, unit. In the present work, the effect of temperature on glycerol conversion was studied from 350 to 550 °C at a constant catalyst-to-oil ratio of 5. The complete glycerol conversion was achieved at elevated temperatures of 430-550°C, having an acetaldehyde yield of 50%. The acetaldehyde yield increases with temperature, peaking at 550°C. The second most common chemical obtained was acrolein with a yield of 7.6% at 430°C. Analytical instruments like GC and NMR spectroscopy techniques were used to analyze the gas and liquid products. IR spectroscopy was used to analyze carbon dioxide deposited over a catalyst during the reaction.

**Extraction and Characterization of Bioactive Compounds from Leaves of *Dimocarpus longan*- By GC-MS**

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**Abstract:**

*Dimocarpus longan*(*longan*), belonging to Sapindaceae family, is an important subtropical fruit tree in South East Asia. Although it is often planted as an edible fruit but can also be used for medicinal purpose. Here, the objective of this study is to profile and characterize the metabolic active compounds present in longan using GC-MS analysis. The longan leaf was collected from the experimental plot of ICAR-CISH, Lucknow and prepared into five different extracts containing solvents of varying polarities by using percolation and fraction method. Results revealed that the methanol extract fraction was observed the best among the various extracts. This finding highlight that the phytochemicals constituents in longan leaves could pave way for the transformation of pharmaceutical and cosmetic industries.

**Keywords:** Alkaloids, Extraction, Flavonoids, Terpenoid, Polyphenol

**Acknowledgement-** The authors would like to express sincere gratitude for the support extended by ICAR-CISH, Lucknow and Integral University, Lucknow

## **Importance of Rheology as an Advanced Analytical Tool in The Performance Analysis of Bituminous Binders**

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### **Abstract:**

In the realm of contemporary infrastructure development, the analysis of bituminous binders' performance holds paramount importance. Bituminous binders, crucial components in asphalt pavements, roofing materials, and waterproofing systems, exhibit intricate viscoelastic behavior under varying environmental and loading conditions. This paper elucidates the critical role of rheological tools in comprehending the performance dynamics of bituminous binders in the current scenario. The rheology of bitumen is a crucial component in the study of bituminous mixtures and is influenced by temperature, loading conditions, additives and mineral fillers. Through rheological tests, such as viscosity measurements, dynamic shear rheology, complex modulus, and creep tests, engineers gain invaluable insights into the material's response to stress, temperature, and deformation. These insights are fundamental for predicting binder performance, optimizing mix designs, and ensuring quality control in manufacturing processes. Rheological tools play a pivotal role in this regard by facilitating the development of eco-friendly binders through the analysis of additives, modifiers, and manufacturing techniques. Furthermore, ongoing research and development efforts leverage rheological analysis to explore novel materials and formulations, driving advancements in bituminous binder technology. This paper underscores the indispensable nature of rheological tools in the performance analysis of bituminous binders, emphasizing their significance in enhancing infrastructure durability, sustainability, and resilience. As infrastructure challenges evolve, rheological analysis remains a cornerstone for informed decision-making, innovation, and progress in the field of bituminous binder engineering.

**Keywords:** Bitumen; complex modulus; creep; rheology; viscoelastic.

### **Analysis of Drinking Water from Different Sources**

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#### **Abstract:**

Water is one of the most crucial and important component in our lives as all the life forms are crucially dependents on it. It plays a supporting role in our day to day life. Its versatility and adaptability help perform important chemical reactions. Water is said to be a universal solvent because of its unique characteristics properties. These days this universal solvent is getting polluted with a lot of foreign substances, there is need to protect it from further damage. This study focuses on various contaminants present in the water from various water bodies in Hyderabad, Telangana.

It is an experimental method of study design, where random samples of water was collected from various water bodies to check the conductivity, PH of water, TDS meter.

Conductivity test was performed and it was observed that conductivity is indirectly proportional to PH resulting in more pollutants and more acidic contents in lake water than tap water. Lake water is not suggested for drinking because of high conductivity and  $P^H$ , whereas tap water, mineral water and filter water are drinkable.

By the research done on the water samples it's been concluded that most of the water bodies present in Hyderabad are highly polluted and are not preferred for drinking also. But because of water shortage the contaminated water is being supplied resulting in infections and diseases. If the same thing continues the future generations can face severe scarcity of water.

**Design and Fabrication of MIP-EQCM Sensor for *Mycobacterium Leprae* Protein**

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**Abstract:**

Leprosy, a chronic infectious disease of humans, is caused by the obligate intracellular pathogen *Mycobacterium leprae*. The bacterium has a long incubation period, making it challenging for diagnosis. Timely diagnosis is crucial in initiating early treatment and preventing disease progression and complications. Thus, an attempt is made to prepare a dual-template epitope imprinted polymer sensor for *Mycobacterium leprae* bacterial protein. Molecularly imprinted polymers (MIP) are capable of generating artificial receptors which are closest to biological receptors in terms of specificity, selectivity and sensitivity. In this study, two peptide (epitope) sequences unique to the bacteria were used to create a dual-template epitope imprinted polymer on the surface of a gold-coated electrochemical quartz crystal microbalance (EQCM) electrode. The epitope sequences were immobilized onto gold nanoparticles through gold-sulphur bonds (Au-S), followed by bulk polymerization using multiple monomers (2-methacryloyloxyethyl phosphorylcholine, benzyl methacrylate, and 4-aminothiophenol) and ethylene glycol dimethacrylate (EGDMA) as a cross-linker, using azobisisobutyronitrile as an initiator. The resulting polymeric solution was electrodeposited on the gold coated EQCM electrode with the aid of an additional electroactive monomer 4-aminothiophenol by using cyclic voltammetry. Extraction of the template molecule left the template-specific cavities in the polymeric matrix. Phosphate buffer solution was used for extraction and verified using HPLC and UV-Vis spectroscopy. The sensor was also applied for the detection of real samples of individuals infected with leprosy disease. Such cost-effective MIP-EQCM sensor will help in diagnosis of disease at an early stage.

**Keywords:** molecularly imprinted polymers, electrochemical quartz crystal microbalance, gold nanoparticles, dual-template epitope imprinted polymers

## Electrochemical analysis of NaSICON Structured $\text{Na}_4\text{MnxFeyCrz(PO}_4)_3$ as Cathode Material for Sodium-Ion Battery

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### Abstract:

Considering the precursors of sodium ion batteries (SIBs) have widely distributed mineral resources in the earth's crust, SIBs have garnered significant attention from researchers in the last ten years. In contrast to Lithium Ion Batteries (LIBs), the  $\text{Na}^+$  exhibits slow kinetics and an irreversible phase change during cycling due to its higher mass and radius. Thus, it makes good practical sense to build a cathode with a high energy density and a robust structure. Although there have been reports of fascinating behaviours from a variety of cathode materials, the structural diversity and 3D open framework of polyanionic phosphate make it a hotspot.  $\text{Na}_3\text{V}_2(\text{PO}_4)_3$  (NVP) in the NaSICON structure and its derivatives have been extensively studied as cathode materials for SIBs with a 3.4 V voltage plateau and a reversible capacity of 110 mAhg<sup>-1</sup>. Apart from NaSICON, which is based on vanadium, the high voltage and capacity of NaSICON-structured cathode materials, such as  $\text{Na}_3\text{MnZr(PO}_4)_3$ ,  $\text{Na}_4\text{MnV(PO}_4)_3$ , and  $\text{Na}_4\text{MnCr(PO}_4)_3$ , make them appealing. As is the case with various transition metals, cathode material performance is not uniform. The electrochemical performance of partial substitution of  $\text{Na}_4\text{MnxFeyCrz(PO}_4)_3$  with three distinct Fe concentrations was examined in this present study. The synthesised material exhibits a rhombohedral structure over an R-3c space group in the refined XRD pattern. The electrochemical performance was negatively impacted by the Fe replacement, leading to a decreased capacity of 86 mAhg<sup>-1</sup>. Apart from reduced specific capacity, rate performance in all three compositions is improved by substituting Fe for Mn due to decreased polarisation in redox pairs. The sodium ion migration barrier explained the improved rate performance after adding more Fe atoms.

**1,3,4-Oxadiazoles as Effective Corrosion Inhibition Against Mild Steel: Synthesis, Electrochemical, Morphological, and Computational Insights**

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**Abstract:**

An easy synthesis of 1,3,4- Oxadiazole derivatives, and their corrosion-inhibition efficacy against mild steel corrosion in 1N HCl, is evaluated using weight loss (303-323 K), Electrochemical Impedance Spectroscopy (EIS), Potentiodynamic Polarization (PDP), Scanning Electron Microscopy (SEM), Energy Dispersive X-ray (EDX), UV-Vis spectroscopy, along with theoretical evaluation. The investigated molecules expressed excellent inhibition efficiency. PDP demonstrated that these derivatives act as mixed-type inhibitors. Density Functional Theory (DFT) calculations and Molecular Dynamic (MD) simulations complement well the experimental outcomes.

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## **Role of Chemistry in National Education Policy 2020**

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### **Abstract:**

National Education Policy (NEP 2020) envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. Chemistry is essential for meeting our basic needs of food, clothing, shelter, health, energy, and clean air, water, and soil. Chemical technologies enrich our quality of life in numerous ways by providing new solutions to problems in health, materials, and energy usage.

## Chromium Substituted Spinel $\text{Co}_3\text{O}_4$ : An Efficient Electrocatalyst Towards OER and MOR in Alkaline Medium

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### Abstract:

In this intriguing study, our central focus revolves around efficiency of the Oxygen Evolution Reaction (OER) and methanol oxidation Reaction (MOR) through a captivating approach: harnessing the power of cobalt valence modulation in Cobaltite ( $\text{Co}_3\text{O}_4$ ), achieved by the enchanting substitution of chromium (Cr). By seamlessly integrating chromium atoms into the crystal lattice of  $\text{Co}_3\text{O}_4$ , our ultimate aim is to orchestrate a remarkable transformation in the potential-determining step of the OER, resulting in a symphony of improved catalytic performance. This substitution is done by utilising simple sol-gel method at low temperatures. This gentle adjustment of cation valence states creates oxygen vacancies on the spinel surface, achieving an ideal ion ratio of  $\text{Co}^{2+}/\text{Co}^{3+}$ . The formation of spinel oxides has been confirmed by a comprehensive range of precise physicochemical techniques including, Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction analysis (XRD), X-ray photoelectron spectroscopy (XPS), High Resolution Transmission Electron Microscopy (HRTEM), scanning electron microscopy (SEM) coupled with energy dispersive X-ray spectroscopy (EDS), Brunauer–Emmett–Teller (BET) technique and Raman spectroscopy. The presence of oxygen vacancy has been verified with Electron Paramagnetic Resonance (EPR) spectroscopy. The spinel oxide,  $\text{Cr}_{1.5}\text{Co}_{1.5}\text{O}_4$  displays superior activity for OER with current density of  $100\text{mA}/\text{cm}^2$  at the overpotential of only 413mV. Our findings highlight the significance of cobalt valence control in promoting OER/MOR activity, paving the way for advanced electrocatalytic systems with enhanced energy conversion capabilities.

**Keywords:** Cobaltite, sol-gel, oxygen vacancies, water electrolysis, methanol oxidation

**Advances in Electron Microscopy and Electron Energy Loss Spectroscopy (EELS) Techniques for the Mechanistic Investigations of Heterogeneous Catalysis in Petroleum Refining Industry and Other Catalysis Processes**

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**Abstract:**

The application of TEM/HAADF-STEM techniques in heterogeneous catalysis have evolved much beyond the conventional high-resolution imaging or Z-contrast imaging in HAADF-STEM.<sup>[1,2]</sup> The development of new techniques such as electron tomography for zeolite-based catalysts, EELS and in-situ TEM techniques have resulted in new advances in the fundamental mechanistic understanding of commercially important heterogeneous catalysis processes which can help us in achieving new and efficient catalysts with more efficiency resulting in lower CO<sub>2</sub> and energy footprint processes in the industry.

Ordered porous Pt-zeolite materials are widely used in several large scale heterogeneous catalytic processes. Pt coking is followed by oxidative regeneration and reduction under H<sub>2</sub>, which is repeated several times.<sup>[3]</sup> Understanding the Pt species present in the nanoporous zeolite matrix during this reduction and oxidative regeneration cycle is limited. I will present mechanistic insights into active Pt species in the zeolite nanopore matrix systematically investigated using HAADF-STEM and electron tomography using Pt-ZSM-5 (0.54 nm × 0.56 nm) as the model system.<sup>[4]</sup> This is the first detailed microscopic investigation to understand the nature and location of active Pt species in microporous ordered zeolites and will help develop next-generation efficient processes with lower energy and CO<sub>2</sub> footprint.

Reactive Oxygen Species (ROS) induced photodegradation is one of the main bottlenecks for commercializing low-cost organic/Perovskite-based thin film solar cells. Beyond photovoltaics, ROS is also responsible for the photodegradation of paints/coatings and polymers exposed to sunlight.<sup>[5]</sup> I have invented a series of Cerium (III) carbonate (CeC) based additives for the degradation of ROS.<sup>[6]</sup> However, the mechanism of Ce (III) based ROS degradation, the role of Ce (III) oxidation state and active species on the catalytic surface was unknown. To elucidate the fundamental working mechanism of this new material system, I coupled HAADF-STEM and EELS with the photocatalytic tests for ROS degradation in the lab. I will be presenting a unique example of a bifunctional catalytic mechanism on solid-state surface and the application of EELS to achieve the fundamental mechanistic insights.

## Role of People in Yamuna River Pollution

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### Abstract:

Yamuna is one of the most polluted rivers in India. Yamuna River start from the Yamunotri glaciers in the Himalayas. The water quality of only one segment (the Himalayan segment) meets the river water quality standards. Normally no water is allowed to flow downstream of the Himalayan segment (Tejewala barrage), especially in the summer and winter seasons to fulfil the demand of water in the surrounding area. Whatever water flows in downstream of the Tajewala barrage is the untreated or partially treated domestic and Industrial wastewater contributed through various drains. The discharge of untreated domestic and industrial effluents has severely affected the quality of Yamuna River and now it falls under the category E, which makes it fit only for recreation and industrial cooling, completely ruling out the possibility for underwater life and domestic supply. Yamuna River is very polluted due to the deposition of solid wastes from various sites. This is the prime reason for the worsening of water quality. The solid waste disposal depends upon the selection of a proper site and several issues like environmental sustainability and socially acceptable. Beyond these direct sources of pollution, the socioeconomic drivers of Yamuna River degradation demand nuanced exploration. Biochemical oxygen demand (BOD) level have actually started to increase between 2005 and 2023. The Yamuna has been reduced to a small stream, draining industrial effluents, sewage, dirt and other toxic substances. There is an urgent need to take stringent measures to alleviate these pollution loads and save an ailing river. This paper advocates for holistic management approaches that transcend traditional silos, emphasizing the need for integrated water resource management strategies that consider the interplay of ecological, use of biodegradation soap as an alternative to renewable energy resources and reduce environmental pollution, social, and economic factors. In conclusion, this review paper underscores the urgent need for collective action to address the multifaceted challenges of Yamuna River pollution. By synthesizing existing knowledge and advocating for evidence-based interventions, we strive to pave the way for a sustainable future where the Yamuna River thrives as a symbol of life, culture, and ecological resilience.

**Synthesis and Optoelectronic Analysis of Green Emissive Tb(III) Complexes based on 1,1,1-trifluoroacetylacetone**

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**Abstract:**

Octacoordinated mononuclear ternary Tb(III) complexes involving 1,1,1-trifluoroacetylacetone as primary ligand and monodentate or bidentate moieties as secondary ligand, were synthesized. Tri-n-octyl phosphine oxide serves as a monodentate moiety with a one donor site (–O), while 1,10-phenanthroline and its derivatives function as bidentate ligands with –N as the donor atoms. The molecular formula and bonding environment about Tb(III) ion in prepared samples were confirmed with the help of elemental analysis and the spectroscopic studies such as FTIR and <sup>1</sup>H NMR, respectively. The optical investigation was concentrated on examining the absorption, excitation, emission and lifetime spectral data of the complexes. The most intense peak in terbium complexes observed at around 545 nm is responsible for their green emission. Thermogravimetric analysis demonstrates the stability of the complexes up to 180°C. The synthesized complexes exhibit significant opto-electronic properties and large thermal stability, making them potentially suitable for display devices.

**Keywords**

Antenna effect; Chemical shift; Decay time; Luminous intensity; Ternary terbium complexes

**Adsorptive and efficient removal of Rose Bengaldye from wastewater by biomass-based adsorbent**

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**Abstract:**

Water is an essential element of our lives; the quality of water is reduced due to industrialization and urbanization. Dyes are among the most common pollutants of water resources around the world. The carcinogenic and toxicological effects of dyes from industrial wastewater pose a serious hazard to ecosystem as well as human health. Various technologies are adopted by the researchers to remove these dyes from wastewater; among which adsorption is widely used technology because of its simple, cost-effective, eco-friendly and commercially viable nature. In this study, we have used the Raw Saccharum munja, as a potential low-cost and biodegradable biosorbent to remove the Rose Bengal dye from aqueous solution. The physicochemical properties of adsorbent were analyzed with different characterization techniques. Effect of different parameters on the adsorption efficiency of the as-prepared biosorbent was studied by carrying out batch adsorption studies. Further, the kinetics, equilibrium and thermodynamics of adsorption process was checked with various models. Moreover, the spent adsorbent was regenerated by using the mixture of acetone and hot water which makes the whole process as economically viable for practical purpose.

**Keywords:** Dyes; Contaminants; Wastewater remediation; Adsorption; Saccharum munja.

**Adsorptive removal of Eosin yellow dye from aqueous solutions using Pennisetum glaucum as a low-cost and green biosorbent**

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**Abstract:**

Acting as a key element for the survival of human and nature, clean water also contributes tremendously to the ever-growing industries in a country. However, the supply of clean water had led to a decrease as pollutants such as dyes had caused a major negative impact on pure and clean main water bodies. In recent years, Biomass waste, which is abundantly available, has been studied as low cost biosorbent for dye sequestration from waste water. The use of biomass waste adsorbents is economically feasible, environmental healthy and found to have outstanding removal capacity of dyes. Eosin yellow is widely used for coloring in various applications, despite its already proved toxicity and carcinogenicity. The plant waste Pennisetum glaucum were applied as potential adsorbent for the removal of Eosin yellow from aqueous solutions. Different characterization approaches were used to investigate the physicochemical properties of adsorbents. Batch adsorption experiments were conducted using synthetic aqueous solutions and the effects of initial dye concentration, initial pH of solution, adsorbent dose and temperature were investigated. With the use of several models, the kinetics, equilibrium, and thermodynamics of the adsorption process were also analyzed.

**Development of Diethylenetriamine-based Mannich Polymer as Corrosion Inhibitor for Application of Oil And Gas Industries**

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**Abstract :**

Mild steel is the material used for transporting pipes and storage tanks in oil and gas industries, and they have the potential to deteriorate in a corrosive environment. The consequence is economic losses and encountering the carbon steel deterioration is the toughest challenge. The problem can be addressed by mitigating corrosion-stimulating elements from exposed metal surfaces. This involves the application of organic or inorganic coatings alongside the utilization of corrosion-resistant metals. Notably, mild steel, a commonly used material in these industries, is susceptible to corrosion. To combat this, corrosion inhibitors are often employed to impede the corrosion process and enhance the longevity of the metal infrastructure. This study investigates the effectiveness of a Diethylenetriamine-based Mannich Polymer as a corrosion inhibitor in mitigating the deterioration of mild steel in both acidic and saline environments. The synthesis polymer was verified with the help of IR and NMR. The anti-corrosion performance of the Diethylenetriamine-based Mannich Polymer was evaluated on mild steel using gravimetric methods, electrochemical impedance spectroscopy (EIS), and potentiodynamic polarization studies (PDP). The FE-SEM and EDX spectroscopy were used to study metal surface morphology after immersion in the corrosive media with and without corrosion inhibitor.

**Keywords:** Diethylenetriamine, Mannich Polymer, mild steel, EIS, PDP

## Pyrolysis of Geranium and Marigold Flower Waste

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### Abstract:

The extraction of essential oils from aroma plants results in the generation of a significant amount of biomass, also known as spent aromatic biomass, which is generally considered waste and needs to be valorized due to its vast abundance. One of the conventional techniques of biomass valorization is pyrolysis, a thermochemical conversion of biomass into bio-oil, biochar, and gases. This study was conducted to understand the characteristics of pyrolysis products of Geranium and Marigold Flower Waste. The pyrolysis experiments were conducted at different temperatures (300 – 450 °C), with a ramping rate of 10 °C min<sup>-1</sup> under an inert atmosphere. Geranium's maximum bio-oil and biochar yield was 21 and 55 wt.%, respectively at 400 °C, and for Marigold Flower Waste, 37 and 32 wt.%, respectively at 400 °C. The bio-oil was characterized with GC-MS to find out the various functionalities at the temperature range, out of which phenolics and aliphatic hydrocarbons in Geranium and Marigold Flower Waste, respectively, were found to increase with temperature. The feedstock was analyzed using TGA, FT-IR, SEM, proximate analysis, and compositional analysis, whereas the bio-char was characterized using FT-IR, SEM, and proximate analysis.

## **Amorphous Zinc Hybrid Metal Organic Framework with Noncoordinated Terpyridine for Selective Metal Capture and Dye Degradation**

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### **Abstract:**

Metal Organic Framework (MOF)-based materials have attracted significant research interests, especially in the removal of heavy metal ions and organic dye pollutants from water. These are regarded as excellent metal ion adsorbents due to their large surface area, tuneable pores, and abundance of active sites. The reported study investigates the photocatalytic degradation of organic dye in wastewater and selective metal capture utilizing a hybrid zinc-based MOF. The multifunctional material is strategically designed by incorporating amine groups into the ZIF-8 matrix with further functionalization with terpyridine to create more catalytic sites for selective binding. The synthesis of ZIF-8 is meticulously achieved via the solvothermal method, resulting in well-defined crystalline architectures further subjected to post-synthetic modification for functionalization. Comprehensive characterization employs advanced techniques, including X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Transmission Electron Microscopy (TEM) to validate the crystallinity and morphological features of hybrid-based MOF with Fourier-Transform infrared spectroscopy (FTIR) to authenticate the grafting of functional groups onto the ZIF-8 scaffold. The synthesized MOF exhibits high adsorption capacity with reasonable photocatalytic activity towards the degradation of various organic dyes under UV/Vis light irradiation and removal of heavy metal ions from an aqueous medium.

**Keywords:** Dye Degradation, Metal capture, Metal-Organic Framework, Water pollution, Photocatalysis

## **Reversible Photoisomerization in Novel Azo-Benzoates using Density Functional Theory: Effect of Substitution and Solvent**

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### **Abstract:**

The design and synthesis of photoswitchable novel azobenzene materials is essential for the development of new and enhanced optical, electronic and biological applications. The chromophoric and isomerization behaviour of azobenzenes finds applications in the photonic switches which are tunable using different substitutions. The aim of the present work is to investigate the switching behaviour of azobenzenes, the effect of substitution and solvent, from both theoretical and experimental point of view. Thus the reversible photoisomerization and photophysical properties of the synthesized novel azobenzene derivatives have been theoretically investigated and substantiated using experimental data. The calculations of photoactivated excited state energies and their chemical properties were carried out by Density Functional Theory (DFT) using with B3LYP functional method and 6-31+ G (d, p) basis model. The results have shown that the length of the trans and cis isomers of the derivatives have different ranges. The symmetrically allowed electronic transitions of  $\pi \rightarrow \pi^*$  type were assimilated by an azo bond in trans isomer, whereas forbidden  $n \rightarrow \pi^*$  transitions in cis isomer were with respect to the non-bonding electrons of nitrogen atoms. The DFT studies at room temperature has shown that the substitutions at different position and polarity of the solvent have affected the inversion pathway of photoisomerization as well as thermal back relaxation at ground and excited states. The difference in the energy barriers of different azobenzene derivatives during thermal relaxation and remarkable photophysical behaviour have shown these as potential candidates for desirable photonic and biological applications. It is envisaged to see the utility of these molecules in the fabrication of devices too.

**Keywords:** DFT, azobenzenes, photoisomerization, thermal back relaxation, photophysical, photoswitches, computational studies

## Carbon Dioxide Sequestration in Subsea Sediments as Solid Gas Hydrate Deposits

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### Abstract:

Implementing carbon capture and sequestration (CCS) technologies is the only way to achieve the net-zero carbon emissions targets. In this direction, hydrate-based carbon dioxide capture and sequestration (HBCCS) in oceanic sediments has received significant interest because of its high CO<sub>2</sub> storage capacity and long-lasting stability in porous media. The current study investigates the storage capacity and kinetics of CO<sub>2</sub> hydrate formation in sediments collected from the Indian Ocean (Arabian Sea sediments). A high-pressure batch reactor was employed to replicate the subsea sediment conditions. Experiments with various sediments containing clay and sand as the main components are carried out. Moreover, considering the slow kinetics of hydrate formation in the subsea environment, the performance of biocompatible additives (Amino Acids) for CO<sub>2</sub> hydrate formation/ dissociation was also evaluated. More precisely, the impact of the following parameters on hydrate formation kinetics and storage capability is explored for successful utilization of HBCCS technology: (i) influence of clayey sediments, (ii) particle size of the sediment, and (iii) additives (hydrate promoter's performance). This study offers vital insights into using HBCCS in oceanic sediments available in the Indian Ocean.

Keywords: CO<sub>2</sub> storage, Gas hydrates, CCS, Clayey sediment, Kinetic model

## Enhanced Natural Gas Storage in the Form of Gas Hydrates Using a New Additive: Application in Energy Storage

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### Abstract:

To achieve the targets set for the gas-based economy, industries are shifting towards natural gas as a clean fossil fuel. In this direction, efficient/economic storage and transport of natural gas are among the concerns. Several storage and transport methods have been explored, wherein the most appropriate are pipelines, liquefied natural gas (LNG), and compressed natural gas (CNG). The major challenges in pipelines are corrosion and poor maintenance. In the context of CNG, safety concerns (due to high pressure ~200 bar) and the low volumetric storage capacity (~230 v/v) are the concerns. Transportation of natural gas as LNG has been considered the most appropriate approach for long distances due to its high energy density/volumetric storage capacity (~600 v/v). However, the extremely low-temperature requirement (–162 °C) makes it more energy-intensive. Therefore, efficient and effective natural gas storage and transport approaches are needed. In this direction, solidified natural gas (SNG) technology has gained significant attention due to its environmentally benign nature, moderate temperature, and pressure requirement, extremely compressed mode of storage, and enormously safe mode of storage. However, the slow kinetics of hydrate formation is always a challenge for its deployment at a large scale. At CSIR-IIP, we are developing and evaluating the performance of various materials (additives) that can promote the rate of hydrate formation and storage capacity. With the addition of one of our additives, the volumetric methane storage capacity of ~138 v/v (volume of CH<sub>4</sub>/ volume of hydrate) is achieved in just 30 minutes of the hydrate formation test.

## Investigating the Drilling Fluids for Gas Hydrate Exploitation

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### **Abstract:**

Deep and ultra-deep oil and gas fields and natural gas hydrate reservoirs (marine/permafrost) are the key enablers to fulfilling the global energy demand. Drilling in such conventional or non-conventional reserves needs special attention and advancement in drilling technologies due to the dearth of experience in gas hydrate exploitation. Particularly, drilling fluids play a critical role in such operations and impose advancement due to the harsh operating conditions. Herein, we are developing various water-based drilling fluids (DFs) and evaluating their performance at hydrate reservoir conditions (Low-Temperature and High Pressure). Moreover, rheological and filtration properties have also been evaluated. Briefly, we are developing bentonite clay-free and xanthan gum /carboxy methyl cellulose-based DFs. Our preliminary results reveal that some of the DFs are having very good filtration control and show shear-thinning behavior. Hydrate formation results show a significant drop in hydrate fraction with the use of mono-ethylene glycol (MEG) in DFs (~50% less hydrate compared to the baseline).

## **A Bio-Based Dual Additive for Simultaneous Inhibition of Gas Hydrates and Corrosion in Oil and Gas Pipelines**

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### **Abstract:**

To fulfill the growing energy demand, oil and gas industries are shifting towards the deep and ultra-deep subsea fields, wherein the subsea pipelines are at high risk of undesirable gas hydrate formation and corrosion. Both the issues would restrict the hydrocarbon flow and cause significant financial losses. The injection of corrosion and hydrate inhibitors separately into subsea flowlines has been the conventional approach to address these problems, which leads to high costs and carbon footprints. Herein, we are developing a single-dosage additive that simultaneously prevents corrosion and hydrate growth/agglomeration. We observed that the addition of our additive reduces the hydrate formation kinetics by a factor of four compared to the baseline. Moreover, a negligible increase in torque signals is observed, which confers the hydrate anti-agglomerating characteristic of our additives. Further, electrochemical experiments show that our additive is an effective corrosion inhibitor (inhibition efficiency ~91%). Our additive could be utilized as an environmentally friendly dual inhibitor in oil and gas pipelines.

**Keywords:** Hydrates, Kinetics, Additives, Natural gas, Morphology, Corrosion.

**Design, Synthesis, and Biological Evaluation of Isoquinoline Based Sigma-2 Receptor Targeted Imaging Agent Tc-THQ- (DTPA) for Breast Tumor Imaging**

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**Abstract:**

Sigma receptors have emerged as significant targets in pharmacology, oncology, and medicinal chemistry, with implications in various physiological and neurological disorders such as Alzheimer's disease, schizophrenia, cancer, and cognitive impairment. Both subtypes of sigma receptors, particularly sigma-2 receptors, are notably over expressed in rapidly proliferating cancer cells, making them promising targets for tumor imaging. This study presents the synthesis and characterization of a novel sigma-2 receptor ligand, THQ-DTPA, utilizing 6,7-dimethoxy-1,2,3,4-tetrahydroisoquinoline (THQ) and diethylenetriaminepentaacetic acid (DTPA). The ligand was further complexed with <sup>99m</sup>Tc to form the radiotracer <sup>99m</sup>Tc-THQ-DTPA. Radiolabeling with <sup>99m</sup>Tc achieved a high yield of 98.0±0.5% using stannous chloride (SnCl<sub>2</sub>) as a reducing agent. The radioligand demonstrated stability in human serum for up to 24 hours, exhibited low hemolysis (<4%), and showed significant binding affinity with sigma receptors isolated from rat liver membrane (K<sub>d</sub> of 16.32±4.93 nM and B<sub>max</sub> of 0.5232±0.06 fmol/mg). In biodistribution studies conducted in triple-negative breast tumor-bearing nude mice, high tumor uptake was observed at 30 minutes post-injection, with a tumor/muscle (T/M) ratio of 3.58±0.09. At 240 minutes, the T/M ratio decreased by 35% in sigma-blocked tumor-bearing mice (1.81±0.16), indicating the ligand's selectivity. Gamma camera imaging revealed a contrast of 3.56 at 30 minutes post-injection. These results suggest that the ligand <sup>99m</sup>Tc-THQ-DTPA binds with high affinity to sigma-2 receptors and holds promise for imaging triple-negative breast tumors.

In conclusion, the present study attempts to establish a highly selective 6,7-dimethoxy-1,2,3,4-tetrahydroisoquinoline-based DTPA analog as a potential sigma-2 receptor-targeted imaging agent for breast cancer imaging.

## **Adsorption behavior of dyes onto *Pennisetum glaucum* in wastewater effluent**

*Sarita Yadav and Surender Kumar*

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### **Abstract:**

Improved understanding of human health risks, environmental persistence, and widespread dispersion of organic and inorganic contaminants has driven ongoing development of stringent regulations for these compounds in water. One of the promising methods of removing of contaminants from the waste water is adsorption. Agricultural waste or by-products can be used as low-cost adsorbents for contaminants removal. Low-cost adsorbents provide particular economic and environmental advantages. Herein, *Pennisetum glaucum* was used for the adsorptive removal of Erythrosine B dye from aqueous solutions for the first time. The prepared biosorbent was analyzed with different characterization techniques to investigate the surface morphologies, functional groups and thermal stability. Batch adsorption studies were conducted to study the effect of different parameters such as contact time, initial dye concentration, biosorbent dosage and pH on the removal efficiency. Further, the kinetics, equilibrium and thermodynamics of the adsorption process were evaluated with the help of various models. Moreover, the results depicted excellent reusability of the biomass for repeated adsorption cycles, making the process economically viable.

**Keywords-** Erythrosine B; Waste water; *Pennisetum glaucum*; Adsorbent

**A Solvent-Free Route for Carboxylated-Chitosan and its Application in Heavy Metal Removal**

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**Abstract:**

The rapid industrialization and population growth of the last century have heightened the demand for energy and raw materials, leading to increased environmental pollution. With fossil fuels proving inadequate, nuclear energy has emerged as a preferred alternative, highlighting the importance of uranium, a crucial raw material. However, uranium contamination, stemming from various sources including nuclear facilities and natural occurrences, poses significant environmental and health risks, necessitating its removal from wastewater. Adsorption, particularly using biomaterials like chitosan, stands out as a sustainable, cost-effective, and efficient method for heavy metal removal. This study focuses on synthesizing nitrogen oxide-mediated carboxylated chitosan, which exhibits significant uranyl adsorption capacity (87.73 mg/g at pH 7.0). Characterization techniques such as titrimetry, FTIR, XRD, and SEM-EDX confirm successful synthesis and highlight the material's potential for uranium removal, offering a promising solution to environmental contamination.

## **Performance and Analysis of Biowaste-infused PLA Composite for FDM 3D Printing**

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### **Abstract:**

Environmentally friendly plastics offer practical substitutes for detrimental non-biodegradable polymers and plastics. Polylactic acid (PLA), a bio-based resin derived from corn starch, stands as a widely utilized thermoplastic polymer in the field of three-dimensional printing due to its remarkable ease of use and biodegradability, contributing to its extensive range of applications.<sup>1</sup> However, there is room for improvement in the mechanical and biological properties of PLA. Biocarbon, sourced from biowaste, has gained attention as a prospective environmentally friendly material, piquing the curiosity of researchers for a wide array of potential applications.<sup>2</sup> The present work focuses on developing a completely sustainable, biodegradable, and eco-friendly PLA-biocarbon composite material for 3D printing. The synthesized additive is characterized by various techniques such as SEM, XRD, TGA-DSC, and Raman spectroscopy. The fabricated 3D-printed samples are subjected to mechanical and thermal testing. While carrying out the performance evaluation studies, the findings indicate that the interplay of extrusion and uniformly size-reduced particles plays a significant role in modifying the mechanical properties of the composite by changing the structure of the polymer blends. The 3D-printed specimen containing biocarbon exhibits a noteworthy enhancement in both tensile strength and flexural properties without compromising thermal properties.

### **Keywords**

3D printing, polymer composites, biocarbon, mechanical properties

**Enhancing mild Steel corrosion resistance in the acidic medium through schiff base surfactants**

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**Abstract :**

The combination of organic molecules and inorganic molecules could act as an effective corrosion inhibitor. Usually, organic molecules make the insoluble layer on the surface of the metal by using the lone pair and  $\pi$  electrons through physical and chemical adsorption.

The present research is focused on synthesizing schiff base surfactants and evaluating their anticorrosion performance on mild steel in an acidic solution. The synthesized molecules carry the positive charge through the protonation in the acidic solution. The initiation adsorption of inhibitor molecules is mainly due to the physical adsorption through electrostatic attraction. In the acidic solution, metal surfaces carry a positive charge over that of the chlorine ions layer. Adding an inhibitor to an acidic solution replaces the chlorine ions from the surface of a metal. It keeps it in a negative charge that helps to attract the positively charged organic molecules and results in high anticorrosion performance. The corrosion inhibition studies were carried out on mild steel in the aqueous hydrochloric acid medium using the gravimetric method, electrochemical impedance spectroscopy, and potentiodynamic polarization studies. The gravimetric analysis was performed at various temperatures. The FE-SEM and 3D profilometry were used to study the surface structure of metal after immersion in the corrosive media without and with corrosion inhibitors.

**Keywords:** corrosion inhibitors, mild steel, electrochemical impedance spectroscopy, potentiodynamic polarization.

## **Development Of Lubricants Using Refined Base Stocks for Sustainable or Circular Economy Developments**

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### **Abstract:**

Every year the world produces more than 41 billion tons of lubricating oils. More than 2.2 billion tons/annum cannot burnt-out during combustion, consumed during use or spilled. Due to growing Automotive industry this quantity will be increased over the year. Re-refining of used lubricating oil is an economically attractive recycling method in terms of resources conservation and environment protection. Used lubricating oil undergoes an extensive re-refining process to remove contaminants to produce good quality base oil for use as re-refined base oil for lubricating oils. It allows processing of hazardous material in a safe and effective way to recover high quality oil product form used oil. Used lubricating oil is generally a mixture of different types and grades of used lubricating oils coming from various automotive and industrial applications. Re-refined base oils can be used to produce lubricants such as motor oil, transmission fluid, hydraulic oil and gear oils. Mineral base oils are classified as API Group I, II, and III. Re-refined base oils meeting API group I quality are mostly produced by re-refiners.

In this paper authors evaluated different types of API GL4 (Gear oil) and API GL5 (Axle oil) oils based on re-refined base oil to assess the performance of these lubricants in comparison to virgin mineral group-II base oil based lubricants. This study includes physico-chemical tests, lab performance tests (Rust, corrosion, low temperature performance and oxidation) and tribological performance test i.e. shear stability, weld load, wear scar diameter and friction performance by MTM. Test results show similar performance of re-refined base oilbased lubricants w.r.t virgin base oil based products mainly in terms of low temperature behaviour, oxidation stability and tribological properties.

## **Cost Effective Solution for Monitoring Environmental Parameters Effecting Analytical Instruments**

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### **Abstract:**

Analytical instruments play a crucial role in scientific research, industrial processes, and environmental monitoring. However, the performance of these instruments can be significantly influenced by environmental parameters like temperature, humidity and pressure etc., Changes in these variables can result in damage, degradation and malfunctions, all of which can have an impact on the accuracy and reproducibility of test results.

Monitoring of these environmental parameters is essential for optimizing the performance of analytical instruments for obtaining the accurate results. In the market these kind of monitoring systems are available with a high price tag. So, there is a need of cost effective solution for monitoring the environmental parameters in a laboratory. We are using different sensors and open ware software tools to get live and periodical data from sensors to the dashboard. We can also alert the user, if there is a deviation in the defined operating conditions to avoid further damage to the instruments and also to the properties of samples and reagents.

## **Analytical Perspective on Black Liquor Utilization**

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### **Abstract:**

Black liquor is a waste byproduct of the paper and pulp industry. Black liquor is a prospective feedstock for sustainable and circular bio-economy. Traditionally considered a problematic waste stream, black liquor undergoes various industry processes to extract valuable components, utility products, bioplastics and biochemicals.

This study investigates the sustainable production of soap from black liquor, a waste byproduct of cellulose extraction, during the alkaline hydrolysis process. This approach addresses environmental concerns associated with waste disposal, repurposing black liquor into soap, and creating a value-added product. The soap formulation is optimized to meet quality standards for cleansing efficacy and skin compatibility, ensuring suitability for various applications. Through this innovative process, black liquor-derived soap offers a sustainable alternative to conventional soap production methods, contributing to environmental conservation and resource efficiency. Using black liquor from sanitary pad production to soap manufacturing presents a sustainable solution to waste management and resource utilization challenges. Moreover, black liquor-derived soap offers a promising alternative to conventional soap production methods, with potential applications across various industries. Further, the idea leads to utility product-making from waste liquor, contributing to a more resource-efficient future.

**Keywords:** Black liquor, waste utilization, soap

**Stabilization and immobilization of Pd(0) nanoparticles over organotellurium ligand functionalized graphene oxide: catalytic application in nitroarene reduction and hydrogen evolution reaction (HER)**

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**Abstract:**

This research work introduces a new promising, robust and thermally stable (electro)catalytic system for nitroarene reduction and hydrogen evolution reactions that uses graphene oxide (GO) anchored palladium based catalytic system. The GO surface is treated with chloroacetic acid, thionyl chloride and then functionalized with a hybrid bidentate ligand system [2-(phenyltellanyl)ethanamine], which acts as a stabilizing and chelating agent for Pd(0) nanoparticles through tellurium and nitrogen donor sites. The covalent linkage of the hybrid ligand with GO sheets and strong binding abilities of Te and N donor sites with Pd(0) NPs provide high stability to GO-TeN-Pd(0). The resulting catalytic system [i.e., GO-TeN-Pd(0)] is thermally stable and stepwise synthesis has been characterized using various techniques such as powder X-ray diffraction (PXRD), X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), high resolution-transmission electron microscopy (HR-TEM), Electron Energy Loss Spectroscopy (EELS), Raman spectroscopy, Infra-red spectroscopy (IR), thermogravimetric analysis (TGA), and Brunauer-Emmett-Teller (BET) surface studies. The catalytic potential of the system has been explored in the reduction of nitroarene reaction under mild reaction conditions at room temperature. This catalytic system also shows high activity in the electrocatalytic hydrogen evolution reaction (HER) with an overpotential of 133 mV to drive 10 mA cm<sup>-2</sup> of cathodic current density. Importantly, our findings may provide insights toward designing more efficient graphene-based (electro)catalysts for water remediation and more efficient energy production.

## Investigating the Impact of Tight Contact Phenomenon on the Role of Zirconium in CeO<sub>2</sub>-ZrO<sub>2</sub> Catalyst for Soot Oxidation

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### Abstract:

Soot particles in diesel engine exhaust adversely impact human health due to their smaller size ( $\leq 2.5 \mu\text{m}$ ), which allows for deep lung inhalation and, subsequently, respiratory problems. It is a carbonaceous material that is a byproduct of incomplete combustion of diesel fuel, often due to improper engine tuning, inadequate air-fuel mixing, or inefficient combustion processes. They also contribute to smog and haze, reducing air quality and visibility. This study delves into the influence of zirconium (Zr) in CeO<sub>2</sub>-ZrO<sub>2</sub> catalyst for soot oxidation. Synthesized CeO<sub>2</sub>-ZrO<sub>2</sub> used the co-precipitation method to prepare a ceria-zirconia-supported 3-weight percent Zr catalyst, which was then tested for soot combustion. The chemical and physical characteristics of the catalyst were evaluated through various techniques, such as Brunauer Emmett and Teller (BET), X-ray diffraction (XRD), and scanning electron microscopy (SEM). To test the catalyst's catalytic activity for soot oxidation in tight contact mode, thermogravimetric analysis (TGA) of nitrogen and air atmosphere was employed. The soot oxidation in the CeO<sub>2</sub>-ZrO<sub>2</sub> catalyst was found to be increased in the tight contact mode, leading to lower T50 values than uncatalyzed conditions at 353°C for the 3% Zr/CeO<sub>2</sub>-ZrO<sub>2</sub> sample, respectively. T50 for the soot was approximately 400°C, which was extremely high. Regarding the uncatalyzed soot, T50 dropped by 47°C for 3% Zr/CeO<sub>2</sub>-ZrO<sub>2</sub>, respectively. Catalysts with lower T50 temperatures are always preferred because the data indicates that they significantly increase soot oxidation at lower temperatures. The value of T50 for real soot (450°C) was found to be 100°C lower than that of the model Printex-U soot, based on a comparison between the two types of soot. Higher soot oxidation was observed in the nitrogen atmosphere at 3 weight percent Zr/CeO<sub>2</sub>-ZrO<sub>2</sub>, resulting in a 15% weight loss in the model soot.

**Keywords:** Diesel oxidation catalyst; Soot Oxidation; Tight contact mode; Emissions; Zirconia; Thermogravimetric analysis

**Development of Diesel-Methanol Blends with Improved Stability, Combustion and Emission**

*Kiran K. Chakrahari, Justin P. R. J., Shanti Prakash, Maya Chakradhar, Ajay Kumar Arora, and Mukul Maheshwari*

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**Abstract:**

In a developing nation like India, fuel demand and consumption have been climbing steadily across various sectors, especially in road transportation. Fossil fuels continue to be the dominant energy source, with around 85% of the country's needs being met through crude oil imports. This surge in fuel consumption has spurred interest in blending biofuels with traditional fuels and exploring renewable energy options. Government of India emphasizes the mandatory blending of biofuel in automotive fuels. Among biofuels, ethanol has emerged as a leading choice for blending with gasoline, which is commonly used in spark-ignition engines and flex-fuel vehicles. However, methanol/ethanol are not suitable for compression-ignition diesel engines without significant modifications, due to their low cetane numbers and reduced lubricity. Hence, it is pertinent to explore the possible blending of methanol in diesel for making feasible blends.

To ensure that alcohols are both soluble and stable in diesel fuel blends, a specific set of additives is required. In methanol-diesel blends, it's vital to maintain sufficient lubricity to safeguard the metal components within the fuel delivery system and engine. Lubricity is a critical standard for diesel fuel, as specified in IS: 1460-2017, and achieving the right dosage of additive packages is essential to preserve lubricity in methanol-diesel blends. To overcome challenges like low cetane numbers, reduced lubricity, and the stability of methanol-diesel blends, the additive package also includes a lubricity enhancer, a cetane booster, and a corrosion inhibitor. The properties of methanol-diesel blends in comparison to conventional diesel are examined, with methanol making up 15% (v/v) of the blend, along with the appropriate dosage of additive package. This paper will explore the key properties and storage stability of methanol-diesel blends.

**Key words:** Diesel, methanol-diesel blend, methanol, Cetane Number, lubricity improver

**CSF Biomass Derived Composite Material for Water Treatment Application**

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**Abstract:**

In recent years, the development of sustainable and efficient materials for water treatment application has emerged significant attention of researchers. In this study, the waste biomass coconut shell is selected to extract the cellulose followed by its conversion to cellulose acetate (CAc) biopolymer. This CAc biopolymer is further used as the polymeric backbone of the membrane for water treatment applications. The synergistic combination of CSF and  $\text{TiO}_2$  offers a unique platform for addressing water pollution challenges. The CSF- $\text{TiO}_2$  composites show enhanced structural, morphological, and functional properties. Green solvent DMSO is used for fabricating the membrane from this composite material. The composite material was derived from coconut shell fiber (CSF) and titanium dioxide ( $\text{TiO}_2$ ). The membrane performance is evaluated by water flux determination and membrane efficacy for water treatment. The pure water flux of  $1818 \text{ L m}^{-2} \text{ h}^{-1}$ , was achieved with a CAc biopolymer and DMSO based membrane. A high oil removal efficiency of more than 97% was achieved. The photo catalytic activity of the material was also studied using spectroscopic techniques. CAc biopolymer from CSF, a natural and renewable resource, has gained prominence due to its abundance, low cost, and eco-friendliness, while  $\text{TiO}_2$  is renowned for its photocatalytic activity and stability. The tailored band gap of the CSF- $\text{TiO}_2$  composite material makes this material suitable for the catalytic application. The developed membrane could be effectively used for waste water treatment.

**Highly Stable Colloidal Silver Nano-particles Stabilized with Anthracene and Pyrene Derived Schiff Bases: Application in Sensing and Catalysis**

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**Abstract:**

Silver nanoparticles have gained significant interest due to their extraordinary size and shape-dependent properties relative to their bulk analogs. They've been explored extensively for a variety of uses, including catalysis and medicine. Metals as well as organic pollutants like nitroarenes are extremely poisonous and pollute the environment. Silver-nanoparticle-based metal ion and anion sensing has gotten significant interest since it enables rapid colorimetric detection at low concentrations. Thus, we have synthesized highly stable silver nanoparticles stabilized with bidentate (N, N) donor ligands (**L1–L4**) appended with anthracene/pyrene units having different spacer. The size of these Ag-NPs is in the range of 10–20 nm as revealed by TEM studies. These NPs serves as selective naked eye sensor for the detection of cations such as  $\text{Hg}^{2+}$  /  $\text{Cu}^{2+}$  /  $\text{Fe}^{3+}$  and anions  $\text{HO}^-$  /  $\text{HSO}_4^-$ . In addition, these NPs have been found extremely reactive for nitroarene reduction reactions. Several nitroarene derivatives have been tested and the reduction process is completed in a few minutes.

### **Role of the Citizens as Chemist in the Society**

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#### **Abstract:**

Every citizen are using Chemicals each moment in the Society but not aware about Chemistry of Chemicals. Chemistry plays an important and enormous role in society about the shelter. Chemists have come up with Chemical paints that protect houses from the effect of tear and wear that is inflicted by sun, wind, pollution, and rain. These Chemicals are professionally designed to make the shelter properties last longer, perform better and look better. The study of Chemistry has helped in the usage of fabrics as per requirement of Human as per their climatic conditions. Fabrics Industry has helped society to create employment. Chemists explains how food changes as we cook it, how to preserve it, why and how it rots, how food ingredients are useful to the body and all importantly, how our bodies utilize the food we eat. Advancement in metal technology; Chemistry is playing an important role in steel industry today by giving a strong foundation to infrastructure development of Bharat. Chemistry is everywhere in our daily lives, and chemists are like the wizards behind the scenes, making sure everything works smoothly. They're the ones who make sure the water we drink is safe, the food we eat is healthy, and the medicines we take are effective. They also help create new materials for technology, like the stuff in our smartphones and computers. But it's not just about making cool stuff. Chemists also have a big responsibility to keep things safe and clean. They work to make sure that the products we use don't harm the environment and that the processes used to make them are as eco-friendly as possible. Chemists develop the formulas for cleaning products we use at home, like detergents, soaps, and disinfectants, ensuring they effectively remove dirt and germs while being safe for us and the environment. Chemists help create processes for recycling materials, like plastics and metals, so that we can reuse them instead of throwing them away, reducing waste and protecting the planet.

**Enhancing Agricultural Sustainability: Evaluation and molecular characterization of *Populus deltoides* clones for resistance against foliar pathogens**

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**Abstract:**

For the healthy survival of a nation, sustainable development is imperative. Changing climates elevate pathogen virulence, leading to an increase in disease outbreaks and epidemics. In India, the important agro-forestry tree species *Populus deltoides* Bartr., confronts severe threats like *Alternaria* leaf spot, blight, and *Melampsora* rust disease, resulting in premature defoliation and a decline in biomass production. This study addresses the urgent requirement for quick screening of poplar clones for environmental stability. To tackle these issues, two key strategies were employed. Initially, an antagonistic fungal strain possessing hyperparasitic properties against rust pathogens was identified and confirmed through foliar application and the cavity slide method. Second, 25 promising *P. deltoides* clones were screened and rated on the basis of the infection scale against *Alternaria alternata* and *Melampsora medusae*. Further screened disease-resistant and susceptible clones to *A. alternata* were characterized using the DNA fingerprinting technique with DNA-based molecular markers (ISSR). For the pathogen identification, a DNA barcode technique with the Internal Transcribed Spacer (ITS) region glyceraldehyde-3-phosphate dehydrogenase (GAPDH), and the beta-tubulin (TUB) gene was used. The results of this study find six resistant clones against *A. alternata* and *M. medusae*. It is suggested that these resistant clones could be deployed for future breeding program to enhance poplar productivity in northern India. Hence, the integrated biocontrol and resistant germplasm approach offers an eco-friendly strategy against foliar pathogens.

**Keywords:** *P. deltoides*, *A. alternata*, *M. medusae*, biological control, resistance screening, DNA fingerprinting.

## Mapping the Hot Deformation Behaviour of Al-Co-Cr-Fe-Ni High Entropy Alloy through Machine Learning

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### **Abstract:**

High Entropy Alloys (HEAs) are new set of alloys that facilitates high entropy in a four to six component system and thus minimises the Gibbs Free Energy. It results into better mechanical performance in comparison to conventional alloys. This study examines the hot compressive behaviour of equiatomic Al-Co-Cr-Fe-Ni alloy at temperatures between 900 and 1150 °C and strain rates of 0.001 s<sup>-1</sup> to 10 s<sup>-1</sup>. The microstructural characterization of hot compressed samples through X-ray diffraction (XRD) indicate that the HEA exhibit a BCC matrix with FCC as secondary phase. Scanning electron microscopy (SEM) investigations reveal two different regions: Region 1 is the BCC matrix showing coarse grains and Region 2 consists of two different phases having lamellar morphology. Artificial neuron network (ANN) model is constructed to predict the flow behaviour of the alloy. The ANN model shows a better predictability with slope of fitted line 0.982 and root mean square error of 0.0208.

**Keywords:** High Entropy Alloy, Microstructure, Phase, Neural Network

**AGHIS-HRMS Characterization of Coker Kero for Producing Alpha Olefin and Alkyl Benzene**

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**Abstract:**

All Glass Heated Inlet System (AGHIS) - High Resolution Mass Spectrometry (HRMS) is a powerful analytical technique generally employed in the petroleum industry to characterize diesel fuels and higher complex hydrocarbon mixtures. In the context of HC22 type analysis, AGHIS integrated with the Autoconcept petroleum platform which is designed to meet the stringent requirements of HC22 and ASTM methods for hydrocarbon group type analysis plays a pivotal role in discerning the distribution of different compound types based on their final boiling temperature from a single analysis. In the present study, up-gradation of 'Coker Kero' was performed by removing Aromatics by following two approaches namely 'Adsorption' and 'Liquid-Liquid Extraction (LLE)'. The HC22-type analysis of Coker Kero showed that it contains total Saturates 55.4 wt%, total Aromatics 41.8 wt% and Sulfur compounds 3.1 wt %. The removal of aromatics from Coker Kero was done using Fuller Earths and Graphitic Carbon as adsorbents and it was found that these two adsorbents remove the aromatics in order of 37.8 wt% and 32.47 wt% respectively. This indicates that Fuller Earths is a better adsorbent for removing 'Aromatics'. The removal of aromatics from Coker Kero was also performed by Liquid-Liquid Extraction (LLE). For LLE, two types of solvents were used namely aromatic solvent (NMP) and non-aromatic solvent (MeOH, Acetonitrile) having different polarity. It was found that NMP is a better solvent to remove aromatics from 41.8 wt% to 12.7 wt% (feed aromatics to product) as compared to MeOH and Acetonitrile. This observation was also validated by FT-IR spectroscopy. Further, it was also observed that MeOH imparts the better color improvement in Coker Kero as indicated by ASTM D-1500 test method.

**Keywords:** AGHIS; Alpha- olefins; coker kero; HRMS; N-methyl pyrrolidone; HC22 type.

**Enhancing Wastewater Purification:  $\beta$ -Cyclodextrin-Based Nanocomposites Target Organic Pollutants Removal**

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**Abstract:**

Addressing the pressing issue of water scarcity necessitates robust strategies for water remediation. Among these, photocatalysis stands out as a promising avenue for environmental remediation, offering a pathway for the elimination of pollutants from wastewater streams.

Within this realm of inquiry, various nanocomposites have been scrutinized for their photocatalytic efficacy. In this study, a novel ternary metal oxide composite, CuO/Fe<sub>2</sub>O<sub>3</sub>/ZnO, is synthesized via the meticulous sol-gel method. Subsequently, this composite is further augmented through modification with  $\beta$ -cyclodextrin ( $\beta$ -CD), yielding the innovative and potent  $\beta$ -CD-CuO/Fe<sub>2</sub>O<sub>3</sub>/ZnO catalyst. Evaluation of the adsorption and photocatalytic activity of these catalysts is conducted under neutral pH conditions, with particular emphasis on their efficacy in degrading dyes, pesticides, antibiotics, and phenolic compounds. The kinetics, mechanisms, and recyclability of these catalysts are meticulously explored.

**Keywords:** Photocatalytic degradation;  $\beta$ -Cyclodextrin; Organic pollutants; Wastewater

**Compatibility of Elastomers with Dimethyl Ether (DME) and Liquefied Petroleum Gas (LPG) Blend:  
An Analogue Solvent Screening Approach**

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**Abstract:**

DME is a non-toxic environment friendly gas with no C-C bond, resulting in no soot formation during combustion, and having physical properties similar to LPG. Due to enhanced focus on sustainability and low emission, DME has been identified as a suitable candidate for blending with LPG. The successful implementation of Dimethyl Ether (DME) blended with Liquefied Petroleum Gas (LPG) as a cleaner fuel relies heavily on the compatibility of elastomers with this blend owing to corrosive nature of the former. However, identifying compatible elastomers poses a significant challenge due to the high pressure involved and safety concerns associated with direct testing using actual DME/LPG blends. To address this, we propose a screening methodology utilizing analogue solvents as a surrogate system for evaluation.

Analogue solvents were selected based on factors such as Hansen Solubility Parameters (HSP) value and chemical similarity. Pentane and diethyl ether (DEE) were chosen as analogue solvents for LPG and DME, respectively. The screening process involves subjecting different elastomers to immersion in the analogue solvents, followed by an assessment of their physical, mechanical, and chemical properties.

Based on the in-depth literature analysis, different elastomers (PTFE, FKM, NBR, and silicone) were selected and tested with analogue solvent. Apart from these, the LPG Suraksha hose used in Indian household was also tested in analogue solvent. Mass extraction and adsorption studies of the elastomers were performed as per IS9798. Compatibility studies and mechanical properties of these materials were examined to analyze the mechanical integrity of the materials.

Results of FKM, PTFE, NBR (Suraksha Hose) were found promising in the screening studies. FKM exhibited compatibility with analogue blend of up to 75%. On the other hand, PTFE demonstrated full compatibility with 100% Diethylether (Analogue of DME). NBR (Suraksha hose) was tested upto 20% DEE and was found compatible. These elastomers were further tested under actual DME/LPG conditions. FKM, PTFE, and NBR (which are used in Suraksha hose), displayed compatibility with the actual 5% DME/LPG (L) blend as per the criteria mentioned in IS9798; Annexure D.

By providing valuable insights into the compatibility of elastomers with DME/LPG blends, this study contributes to the wider adoption of DME blended LPG as an environmentally friendly fuel option. The findings of this research will aid in the selection and development of elastomer materials suitable for DME/LPG fuel applications, promoting safe and reliable utilization in various industries.

## The Spectroscopic and Computational Study of Anthracene Based Chemosensor - Ag<sup>+</sup> Interactions

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### Abstract:

Here in, presented a selective detection of Ag<sup>+</sup> ion by the anthracene-based schiff base sensor AMC. The recognition event among sensor AMC and Ag<sup>+</sup> ion was investigated by enhanced absorption band, red-shifted quenched emission spectra, electrochemical studies and DFT computational studies. The presence of Ag<sup>+</sup> ion to solution of AMC quenched almost 50 % emission intensity of the ligand band. Data from high-resolution electrospray ionization mass spectrometry (ESI-HRMS), Ag<sup>+</sup> titrations, and Job's plot studies all show that Ag<sup>+</sup> binds to AMC in a 1:1 stoichiometric ratio. The quantitative parameters of sensor for silver ion are determined as the limit of detection (LOD)  $5.95 \times 10^{-7}$  M, and limit of quantitation (LOQ)  $1.98 \times 10^{-8}$  M in the linear range  $3.48\text{--}20.31 \times 10^{-6}$  M with good association affinity of  $5.030 \times 10^3$  M<sup>-1</sup>. LMCT phenomenon from insilico studies, is in good agreement with the results obtained from other performed spectroscopic techniques. In addition, this sensor AMC was also successfully applied to real water samples for the identification and measurement of Ag<sup>+</sup> ions.

**Semiconductor–Molecular Catalyst Hybrid Materials for CO<sub>2</sub> Reduction Catalysis**

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**Abstract:**

Electro and photocatalytic CO<sub>2</sub> reduction is the quintessence of modern-day sustainable and catalysis research. Ideal CO<sub>2</sub> reduction reaction (CO<sub>2</sub>RR) catalyst should avoid competitive H<sub>2</sub> evolution reaction (HER), maintain product selectivity, and work efficiently with low overpotential requirements. 1,2 3D transitional metal complexes of porphyrins have shown efficient electro and photochemical CO<sub>2</sub>RR performance as molecular catalyst, and promising to incorporate them in electrolyzer or photocatalytic reactor.<sup>3</sup> On the other hand, nanocrystalline light-absorbing semiconductor materials can generate and store multiple charges upon suitable bandgap irradiation across the solar spectrum. We have developed hybrid catalyst films as a model photocathode system to study the photo and photoelectrochemical CO<sub>2</sub>RR. The hybrid systems comprise Glass-FTO coated mesoporous metal oxide (TiO<sub>2</sub>, SnO<sub>2</sub>, etc.) anchored with Fe-porphyrins. In hybrid catalyst films, electron transfer occurs at the interface of the metal oxide/metalloporphyrin system and its impact on the CO<sub>2</sub>RR catalysis performances is investigated. <sup>4</sup> We have performed transient absorption spectroscopy to monitor the kinetics of the photoinduced electron transfer at the interface of the films, possible recombination processes, and correlate the effect of the electron transfer process with their CO<sub>2</sub>RR/ HER catalysis performances.

**Seasonal Occurrence, Characterization and Abundance of Microplastic In Wastewater Treatment Plants in Uttarakhand, India**

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**Abstract:**

Microplastic (MP) load in urban sewage sludge could vary annually in wastewater treatment plants (WWTPs) depending on seasonal precipitation and human activities. We investigated the seasonal dynamics in abundance and characterization of MP loading in WWTPs located in two cities across the ecologically sensitive stretch of River Ganga, India. During a 12-month seasonal sampling (pre-monsoon, monsoon, and post-monsoon), sludge samples (n=36) (primary sludge, PS; drying bed sludge, DBS) were collected and analyzed for load, polymer types, shape, colour and size (20  $\mu\text{m}$  – 1000  $\mu\text{m}$ ). Across the three seasons, MP concentrations (particles/kg) were found to be in the ranges of  $93.4 \pm 5.0 \times 10^3$  –  $189.4 \pm 11 \times 10^3$  in the PS and  $39.6 \pm 4.0 \times 10^3$  –  $152.0 \pm 7 \times 10^3$  in the DBS. The trend of MP loading was in the order: of monsoon > post-monsoon > pre-monsoon. The dominant MP size was 50  $\mu\text{m}$  – 200  $\mu\text{m}$  (36.22%) followed by, 20  $\mu\text{m}$  – 50  $\mu\text{m}$  (27.65%), 200  $\mu\text{m}$  – 500  $\mu\text{m}$  (24.55%) and 500  $\mu\text{m}$  – 1000  $\mu\text{m}$  (11.58%). ATR-FTIR results revealed polypropylene, polyethylene terephthalate, polyvinyl chloride, and nylon as dominating MP in sludge. This study highlights the importance of long-term monitoring of MP loading in sewage sludge to offer a more accurate estimate of MP contamination in sludge from WWTPs and develop a possible mechanism for its elimination to safeguard the environment.

**Keywords:** Microplastic, Seasonal Variation, Sludge, Plastic pollution, Polymer types.

**Dual application of duckweeds *Spirodela polyrhiza* and *Lemna minor* in urban wastewater reclamations and biofuel feedstock production**

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**Abstract:**

Duckweed (DW) has appeared as a promising bio-tool for converting wastewater nutrients into added-value biomass for feedstock generation under phytoremediation approaches. In this study, we investigated the potential of two duckweed species (*Spirodela polyrhiza* and *Lemna minor*) in urban wastewater treatment and phyto-mass generation. Batch scale setups (5 L) of urban wastewater were prepared for DW inoculation and a separate setup with Hoagland media acted as experimental control. Changes in physiochemical properties of wastewater were examined for 21 days and DW biomass was harvested after each 7 days interval for DW growth and biochemical analysis of biomass. DW caused an efficient reduction in respective values of EC (38.96%), TSS (72.73%), TDS (69.78%), COD (51.77%),  $\text{NO}_3^-$  (59.72%),  $\text{PO}_4^{3-}$  (65.87%),  $\text{SO}_4^{2-}$  (47.31%) with *Spirodela polyrhiza* and EC (39.59%), TSS (77.63%), COD (52.27%),  $\text{NO}_3^-$  (65.01%),  $\text{PO}_4^{3-}$  (71.15%),  $\text{SO}_4^{2-}$  (50.45%) and TDS (74.47%) with *Lemna minor*. DW showed a high growth rate (5.94 - 10.272  $\text{mg d}^{-1}$ ), biomass yield (5.12 - 7.90  $\text{g/m}^2 \text{d}^{-1}$ ), and RGR (24.42 - 42.72  $\text{g m}^{-2}\text{d}^{-1}$ ) in wastewater inoculated setups with high content of protein (19.00 - 29.66 %), carbohydrate (328.21 - 335.39  $\text{mg g}^{-1}$ ) and lipids (138.83 - 159.28  $\text{mg g}^{-1}$ ), suggesting its suitability as feedstock for bioenergy conversion. Fatty acid profiling indicates the presence of palmitic acid (45.93% and 23.98%), linoleic acid (13.83% and 16.5%), and linolenic acid (40.24% and 34.51%) in DW biomass suggesting its potential in bioenergy feedstock production under waste-to-wealth approaches.

**Keywords:** *Biofuel; Phytoremediation; Wastewater treatment; Renewable energy, C:18 compounds*

**Kinetic Assessment of Copper (II) Catalysed Oxidation of Lysine by Hexacyanoferrate (III) : A Mechanistic Pathway**

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**Abstract:**

The redox reaction of lysine with hexacyanoferrate (III) catalyzed by Cu (II) in an alkaline medium has been investigated. The reaction shows first-order dependence respecting the both reactant. The reaction rate is first-order respecting Cu (II) and is enhanced by medium according to the equation  $k_{\text{obs}} = a + b[\text{OH}^-]$ . The reaction rate is also affected by the ionic strength in increasing manner. The thermodynamic parameters of the reaction have been estimated using the Eyring equation. The oxidation product of lysine has been identified through spectral analysis. Furthermore, the reaction has been examined in various organic solvents, and the solvents effect has been investigated by Taft's and Swain's multiparametric equations. The rate constants have been found to correlate well with Kamlet-Taft's solvatochromic parameters ( $\alpha$ ,  $\beta$ ,  $\pi^*$ ). The reaction constants have not influenced by the solute-solvent interactions. On the basis of kinetic results, a plausible reaction mechanism has been proposed.

The proposed mechanism is reinforced by additional evidence from density functional theory (DFT) computations conducted at B3LYP/6-311\*G (d,p) level, which demonstrate that the activation energy barriers align with the reactivity trend observed in the kinetics experiments. Therefore, these computational results provide further support for the proposed mechanism.

**Keywords:** Copper (II) Catalyst, DFT, Hexacyanoferrate (III), Lysine, Oxidation Kinetics, Reaction Mechanism.

## **Post-Mortem Analysis of BSVI Auto-Catalyst after Field Run: Performance and Characterization Study**

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### **Abstract:**

The introduction of BSVI emission regulations in April 2020 demanded multicomponent after-treatment systems [ATS] for heavy-duty diesel vehicles, which include DOC, CSF, SCR, and ASC components inevitably. Also, advanced TWC with unique designs were required for light-duty gasoline and ultra-light-duty gasoline vehicles 2W to meet BS6 legislations. After the catalyst had been run in the field on a vehicle, performance, and characterization were conducted to assess the impact of field conditions. This paper focuses mainly on DOC, SCR, and TWC catalysts and comprises a comprehensive analysis of catalyst performance metrics, including conversion efficiency, chemical composition, and structural integrity. DOC being the first catalyst placed in the ATS faces the highest amount of contamination coming from fuel and oil i.e., the presence of S, P, and Na elements, while the latter component shows lower amounts which can be detected by using the XRF technique. SCR catalysts observed urea deposition on the inlet face and other contaminants in the urea solution upstream of SCR. TWC catalyst also showed the effect of field thermal and lean/rich operation under gasoline engine conditions. Characterization was done using XRF and BET SSA techniques to analyze chemical and thermal exposure. Johnson Matthey is globally renowned as a leader in the development of auto catalysts for heavy-duty, light-duty, and ultra-light-duty vehicles. In this context, Johnson Matthey aims to underscore how these analytical techniques aid in investigating the factors that compromise catalyst performance, alongside proposing effective measures to address these abnormalities. Keywords: Automotive emission control, Catalyst deactivation, Analytical techniques, Emissions Norms, Post-Mortem Analysis

## **A facile synthesis of Graphene/ NiO aerogels for removal of wastewater contaminants from aqueous environments**

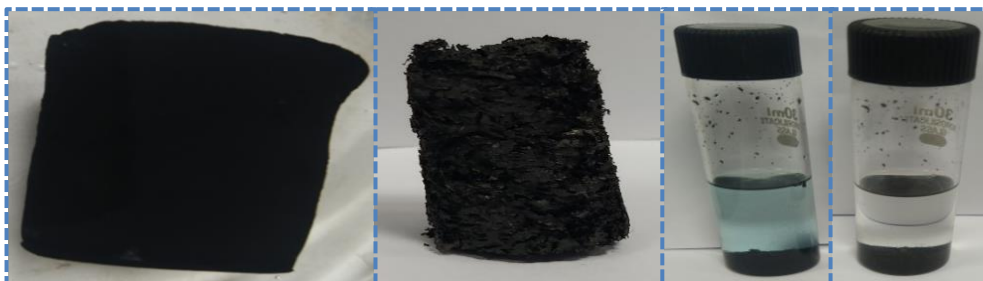
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### **Abstract:**

Water decontamination by engineered adsorption is a promising technology to address water scarcity. However, low adsorption capacity, high cost, and poor recyclability limits sustainability of the most sorbents. Therefore, efficient sorbents that have capability to deliver practical solutions are always in high demand. Herein, we introduce a highly light weight aerogel consisting of cross-linked graphene like layers and NiO nanoparticles. Various spectroscopic and microscopic techniques viz. FTIR, XRD, Raman and SEM etc. are used to study structural and morphological characteristics of the proposed aerogel. The porous framework has large specific surface area of 620 m<sup>2</sup>/g, exhibits excellent methylene blue adsorption capacity of 450 mg/g, showing almost 25 stable adsorption-desorption cycling performance under diverse range of pH, temperature and ionic strength. The formed aerogels can be further upcycled in end-of-life disposal process. This work provides effective strategy to develop low cost and environment friendly adsorbents for efficient wastewater remediation.

**Keywords:** Aerogels, graphene, metal oxide nanoparticles, adsorption technology, water pollution, methylene blue.



**Treatment of wastewater from petroleum refineries by microbial fuel cells**

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**Abstract:**

Wastewater from the refining process ranges from 0.4 to 1.6 times the volume of the refined crude oil. Petroleum Refinery wastewater (PRW) is a mixture of water-soluble hydrocarbons, such as phenol, benzene, and xylenes, as well as other carcinogenic contaminants depending on the refinery's size, kind of products, and operational difficulties. Petroleum refineries utilize a lot of water because of their size, the kinds of products they produce, and the difficulties of their operations. Water-dispersible hydrocarbons found in petroleum refinery wastewater (PRW) can be treated in a variety of ways that physical separation techniques cannot handle. The novel PRW treatment technique is the use of microbial fuel cells (MFC). Advanced oxidation techniques, such as photocatalytic and photo-Fenton methods, which are predicated on the direct oxidation of water-dissolved hydrocarbons, have been developed recently for the treatment of PRW. However, a significant amount of oxidant, a catalyst, and a lot of energy are needed for each of the aforementioned procedures. Microbial fuel cells, an indirect oxidation technique for treating PRW, are thought to be cost-effective because of their power generation, which powers the treatment unit in addition to their low energy requirements. Wastewater resources can be used in a practical and feasible way by treating PRW with MFC technology, which lowers energy usage while also recovering chemical energy from the wastewater.

**Bioconversion of food waste mixed with composted wheat straw and cow dung mixture using black soldier fly larvae under waste-to-wealth approach**

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**Abstract:**

Food waste disposal has become a global problem and its unsafe disposal cause various environmental and economical issues for urban settlements. Converting food waste into added value products could be a sustainable approach to address these issues with multiple benefits. In this study we investigated the bioconversion of food waste (FW) using black soldier fly larvae (BSFL) after blending with composted wheat straw and cow dung mixture (BM). Food waste was mixed (w/w) with composted substrate in different combinations (25, 50, 75 and 100%) and fed to BSFL until the emergence pupa. BSFL caused significant changes in the physiochemical properties of feed stock suggesting its suitability as bio manure. BSFL showed high growth rate, relative growth rate (RGR), bioconversion rate (BCR) and better feed conversion ratio (FCR) value in 25% FW substrate suggesting its suitability for high bioconversion results. The spent material (frass) showed considerable level of TKN (14.01-17.51%), TP (53.06-70.26mg/g), TK (5.25-17.04mg/g), and TOC (66.59-93.87%) suggesting its suitability as potting media for crop production. BSFL biomass chemical analysis revealed the high content of protein (3.66-4.71%) and lipid yield (14.13-37.20%) which indicated that such biomass could be valuable feed for animal farming system. In conclusion BSFL could be a valuable biotechnological approach for converting FW into protein-rich animal feed and added-value bio manure for crop production under circular economy approach.

**Keywords:** *Black soldier fly; food waste; bioconversion; composted wheat straw; circular economy*

## **Developing Slow-Release Fertilizer Using Pyrolyzed Frass**

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### **Abstract:**

Chemical fertilizer boost plant growth and crop productivity but at the same time also cause nutrient leaching, soil acidification, and other soil fertility related issues. Biochar-based slow release fertilizers (SRF) gaining much attention now-a-days due to multiple benefits. This study aimed to investigate the nutrient release behaviour of pyrolyzed frass of Black Soldier Fly Larvae (BSFL, *Hermetia illucens*) cultivation. Frass was pyrolyzed at 350 °C in anaerobic condition and initial characteristics (char yield, surface morphology, proximate analysis, elemental composition) were analysed and then slow release behaviour of it was measured through soil incubation tests. Proximate analysis revealed the respective content of ash, volatile matter, fixed carbon, and moisture content as 12.2%, 79.5%, 0.8%, and 7.5% respectively for BSFL frass. Elemental analysis revealed high content of carbon with desirable H/C ratio, suggesting its suitability as C source in soil and long time carbon sequestration. Soil incubation setup indicate the respective release of N-P-K in soil as 83.3%, 36.2%, and 37.3% in first ten days and cumulative release found to be 96.6%, 48.1%, and 85.1% after 35 days of incubation period in soil. Results revealed the slow release behaviour of pyrolyzed frass suggesting its suitability as slow release fertilizer for optimal soil nutrient management and plant growth support. Pot experiment (soil blended with SRF) also suggested high plant growth and N-P-K uptake in studied moong bean (*Vigna radiata*). In conclusion, frass could be valuable substrate for preparing SRF under waste-to-wealth approach.

**Keywords:** *Biochar, Crop production, Sustainable Farming, Waste-to-Wealth*

**Impact of Sodium Salts of Acetic Acid and Benzoic Acid on Aggregate Formation of 1-butyl-3-methylimidazolium dodecyl benzene sulphonate [bmim][DBS] in Aqueous Medium: A Surface Tension and Electrical Conductivity Study**

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**Abstract:**

The sodium salt of acetic acid and benzoic acid ( $0.01 \text{ mol}\cdot\text{kg}^{-1}$ ) significantly affect the aggregate formation of synthesized ionic liquid 1-butyl-3-methylimidazolium dodecyl benzene sulphonate [bmim][DBS] in aqueous medium. The salting-out effect of sodium salt of acetic acid and benzoic acid is observed by exploiting the surface tension and electrical conductivity techniques. Surface tension measurements have been performed at 298.15 K. From the observed data various surface parameters viz. critical aggregation concentration (CAC), adsorption efficiency, interface surface pressure, surface tension at CAC, minimum surface cover by a single molecule and maximum area excess concentration has been calculated from surface tension measurements with and without salts. Electrical conductivity measurements have been achieved at 288.15 K to 308.15 K. By taking in account of electrical conductivity knowledge various thermodynamic parameters are computed. The results showed that inclusion of sodium benzoate has higher binding potential on aggregate surface, produces maximum salting-out effect and its development leads to decrease in CMC of IL.

**Imidazolium based basic ionic liquid supported over dendritic mesoporous silica nanospheres possessing a magnetic core: A green approach for the synthesis of 4H-benzo[b]pyrans**

Archana Agarwal and Subho Mozumdar

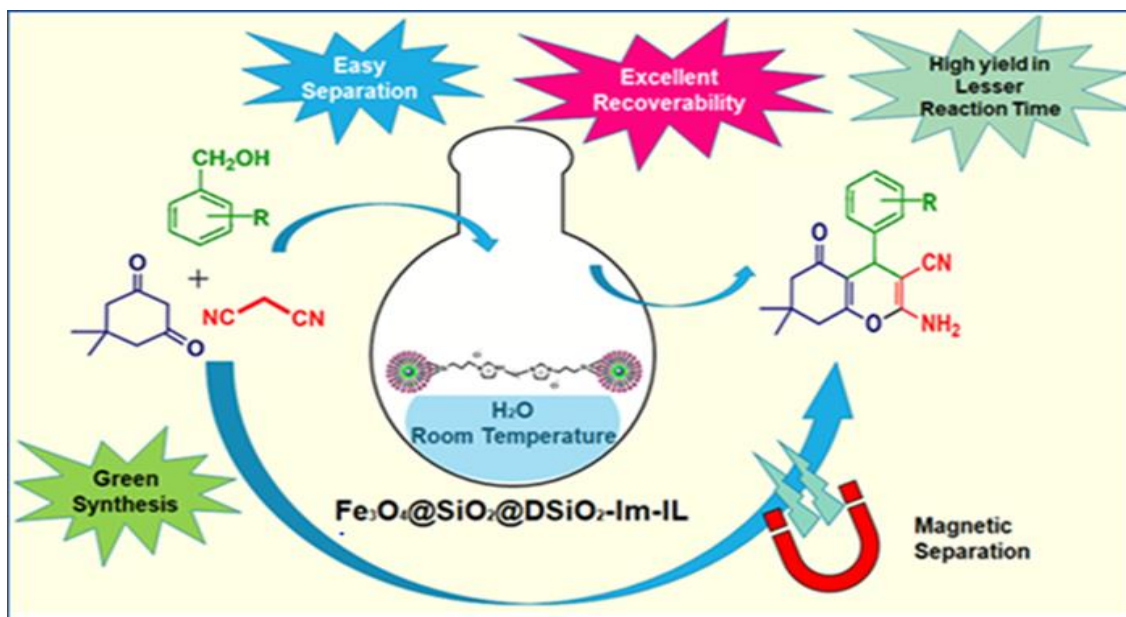
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**Abstract:**

Magnetic core-shell dendritic mesoporous silica nanospheres immobilized with imidazolium based dicationic ionic liquid have been successfully developed as an effective nanocatalyst. The structure, morphology, thermal stability, and the magnetic behaviour of the synthesized magnetic nanocatalyst were successfully determined by different physiochemical techniques like FT-IR, P-XRD, FE-SEM, TGA, VSM, BET and TEM analysis. Finally, the efficiency of the synthesized heterogeneous nanocatalyst has been investigated for the green synthesis of numerous 4H-benzo[b] pyran derivatives by employing different aldehydes and active methylene compound. The catalyst exhibits its efficiency in terms of less catalyst loading, wide substrate scope and high product yield even at room temperature. The synthesized material was found to be effectively recyclable by applying external magnetic force.

The preparation of the catalyst is cost effective, shows atom economy with the utilization of green solvent and without any waste production, The preparation of the catalyst is cost effective, shows atom economy with the utilization of green solvent and without any waste production, which confirms its greener pathway for the synthesis of the Benzopyran derivatives.



**Keywords:** 4H-benzo[b] pyran , dendritic, imidazolium, nanocatalyst, recyclable.

Paper ID: IAC-24-119

**A Sustainable & Swift Approach for Chloride & Oxygen Analysis in Bio Feed Stock**

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**Abstract:**

World is rapidly moving towards developing sustainable technology that helps to produce fuel having less Carbon footprint. To achieve these, different types of biomasses used as feed stocks. These feed stock's physio and chemical properties are way different from conventional fossil source. To understand the feed stock properties a complete new analytical approach is imperative. Chloride and Oxygen level in ethanol-based feed is critical for commercial operation. Chloride leads to corrosion issue and Oxygen level indicates the level of Oxygenated species. The upgraded version of methods that accommodate these two parameters help R&D and commercial operation as well.

**Study of Isotope Ratio Mass Spectrometry of *Santalum album* L. (Sandalwood)**

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**Abstract:**

*Santalum album* L. (Santalaceae) commonly known as Indian Sandalwood is one of the ancient and precious sources of natural fragrance with immense medicinal and commercial significance. It has been grown in India for the last 25 centuries and known to all over the world for its sweet, long-lasting and medicinally valued fragrant oil. Sandalwood heartwood and its essential oil have been used in various traditional systems of medicine, like Ayurveda, Siddha and Unani medicine in the treatment and prevention of wide range of ailments.

The natural abundances of stable isotopes for any given element are not constant in nature due to a great variety of physical and chemical processes that constantly occur. The isotope ratio mass spectrometry (IRMS) is a potential tool that allows us to measure these small variations in isotopic abundances of the major elements in nature (H, C, N, O, S) with high precision. It provides information about the geographic, chemical, and biological origins of substances. There is increasingly widespread use in disciplines such as archaeology, medicine, geology, biology, food authenticity, and forensic science. The aim of the present study was to investigate the ratio of carbon isotopes, <sup>12</sup>C and <sup>13</sup>C of Sandalwood collected from different geographical regions (Kerala, Rajasthan, Karnataka, Uttarakhand, Gujarat, Tamil Nadu, Assam, Chattisgarh, Odisha) of the country. Carbon isotope composition (<sup>13</sup>C/<sup>12</sup>C) was studied on wood samples from diverse locations using Isotope Ratio Mass Spectrometry. The value of <sup>13</sup>C/<sup>12</sup>C ratio observed for different samples of sandalwood from different locations varied from 22.11% to -29.81 %.

**Keywords:** Isotopic Ratio Mass Spectroscopy, *Santalum album*, timber tracking, provenance, climate.

**Analytical Study of Natural Pigments (Astaxanthin, Retinol & B-Carotene) in Biological Samples by HPLC-PDA Technique**

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**Abstract:**

A new method was developed for the separation and estimation of Astaxanthin, Retinol & B-carotene in biological samples solution by HPLC-UV technique. These are industrially important compounds used in Pharmaceutical and Nutraceutical formulations and a bioprocess is being developed. Desired separation was achieved within 10 min using mixture of acetone and methanol as mobile phase in ratio of 70:30 on Dionex C18 Column (250x4.6mm, particle size 5  $\mu$ ) at 30 °C. Calibration curves for all the components such as Astaxanthin, Retinol & B-carotene in the concentration range of 10-100 ppm were plotted and it was observed that the correlation coefficient ( $R^2$ ) lies in between 0.993 and 1.0. Relative standard deviation (RSD) observed for all the above mentioned plant pigment were in the range of 6.4-8.4 %. The order of elution of above molecules are like this Astaxanthin first, then Retinol and at last B-carotene eluted from the column. Biological samples were appropriately diluted with mobile phase and injected into the injector of HPLC system for analysis & detected at 320 & 460nm using UV-Visible detector. Astaxanthin and B-carotene were found in the samples in the range of 10-1500 ppm. The major peak in the samples is identified as Astaxanthin. The operational simplicity of this method in terms of accuracy and precision can be a good method for the estimation of above molecules in plant derived biological samples.

**Keyword:** HPLC, Plant pigment, Reverse phase, PDA Detector etc.

## **Removal of Diclofenac from Aqueous Solution Using Engineered Biochar**

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### **Abstract:**

Diclofenac, a widely used pharmaceutical compound, poses a significant environmental threat due to its persistence and potential adverse effects on aquatic ecosystems and human health. In response, sustainable and efficient methods for its removal are imperative. Biochar a carbonaceous material derived from biomass pyrolysis, has emerged as a promising adsorbent for pharmaceutical removal due to its high surface area, porosity and surface reactivity. Pristine biochar possess certain limitations prompting to the development of modified biochar. In this study, pine needles were pyrolyzed to synthesize pine needle biochar and treated with Manganese Chloride ( $MnCl_2$ ) to synthesize Manganese modified pine needle biochar as an adsorbent for the removal of diclofenac from aqueous solution. Fourier transform infrared (FTIR) analyses confirmed the successful attachment of manganese onto pine needle biochar. The manganese modified pine needle biochar has characteristics for diclofenac adsorption, achieving a 33% removal rate of diclofenac. Keywords: Biochar; Adsorption; Manganese Chloride; Diclofenac; Pine Needle.

## **Methylene Blue Dye Removal and Energy Generation in Rice Husk Biochar Augmented Constructed Wetland-Microbial Fuel Cell System**

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### **Abstract:**

Constructed wetland-microbial fuel cell (CW-MFC) have emerged as a sustainable approach for wastewater treatment and energy generation. In this study simulated textile wastewater containing methylene blue dye at two distinct dye concentrations of 50mg/l and 100mg/l, was treated in biochar amended vertical flow constructed wetland system planted with *Acorus Calamus* (preliminary study). The results showed that biochar and activated sludge augmented systems showed methylene blue dye color removal efficiency of 99.9%, and effective nutrient removal. Furthermore in the next setup biochar augmented integrated CW-MFC planted system were established to study dye removal and degradation. The integrated system achieved maximum power density of 1.13 mW/m<sup>2</sup> and average dye removal efficiency of 99%. This biochar and MFC integrated system offers a sustainable solution for dye removal while harnessing energy from microbial degradation process. CW-MFC system gives dual benefits of pollutant removal and renewable energy productions. Keywords: Nature based solution; Azo dye; Textile effluent; Biochar; Wastewater; Bioenergy

## Effect Of Alkyl Chain on Micellisation Properties of Dodecylsulfate Based Surface Active Ionic Liquids Using Conductance, and Surface Tension Techniques

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### Abstract:

Two surface active Ionic Liquids (ILs) having 3-methyl-1-pentylimidazolium, 1-heptyl-3-methylimidazolium cationic moiety and dodecylsulfate anionic moiety i.e [C<sub>5</sub>mim][DS] and [C<sub>7</sub>mim][DS], have been synthesized. <sup>1</sup>H-NMR, Thin Layer Chromatography were done for their characterization. These ILs have lower critical micelle concentration (CMC) in comparison with their conventional sodium dodecylsulfate [Na][DS] surfactant and hence are highly surface active. The conductance, surface tension, techniques were used to determine the CMC values of Ionic liquid in aqueous solution. Drug atropine has been selected as an additive to study the aggregation behaviour of DS based ionic liquids at two concentrations of atropine in aqueous solutions. Conductance and surface tension techniques were employed to study the aggregation behaviour in aqueous conditions. By Surface Tension technique various surface active parameters were evaluated at 298.15 K. Conductance measurements were performed at three rising temperatures (288.15, 298.15, and 308.15) K and hence calculated the thermodynamic parameters.

**Keywords:** 3-methyl-1-pentylimidazolium dodecylsulphate and 1-heptyl-3-methylimidazolium dodecylsulphate ionic liquids, Drug- atropine, conductance, surface tension.

### Highlights:

- Two ionic liquids 3-methyl-1-pentylimidazolium dodecylsulphate and 1-heptyl-3-methylimidazolium dodecylsulphate ionic liquids have been synthesised.
- Drug Atropine has been selected as additive where the micellization behaviour of IL's has been studied.
- Conductivity is used to find the thermodynamic parameters of micellisation and surface tension technique is used to evaluate the surface activity.

**Activity of Soil Enzymes in *Cyperus Alternifolius* Planted Constructed Wetland Systems Treating Chemical Fertilizer Wastewater**

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**Abstract:**

Constructed wetlands (CWs) represent a nature-based solution for wastewater treatment, harnessing biological, physical, and chemical processes for pollutant removal. Enzymes serve as catalysts in organic matter degradation within CWs, influencing overall treatment efficiency, yet its dynamics and relationship with various environmental parameters remain understudied. Through controlled experiments, this study elucidates the synergistic effects of microbial community (activated sludge) in *Cyperus alternifolius* planted and unplanted systems with one control, for the treatment of simulated chemical fertilizer wastewater. CWs were monitored in two phases; with the total nitrogen (TN) concentration of 98 mgL<sup>-1</sup> and 128 mgL<sup>-1</sup> in phase I and phase II respectively. Enzymes including urease, phosphatase, dehydrogenase were analyzed from the top layer soil samples after the completion of phase I. Results indicated that the activity of urease was 91% and 85.50 % higher in planted CW (CA) in comparison to control (C) and only activated sludge system (AS) respectively. Also, the presence of phosphatase was upto 18% more in CA compared to AS and C, indicating that the coexistence of plants and activated sludge enhances enzymatic activity, potentially attributed to increased microbial diversity and metabolic pathways. In conclusion, this study underscores the significant influence of plant and microbial community on enzymatic activity in CWs.

Keywords: Enzyme activity; Chemical fertilizer wastewater; Constructed wetlands; Urease; Nitrogen

## Development of Novel Triazole Based Multifunctional Additive for Lubricant Applications

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### Abstract:

A lubricant is a substance that helps to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generation and maintenance costs and avoids the wear and tear in the engine. A lubricant consists of base oils as significant constituents and a number of additives as minor constituents. The predominately crude oil-derived composition of lubricants is associated with their potential toxicity and adverse effects on the environment and human health. Disposing petroleum-based lubricants after operational life also poses environmental risks to aquatic life. The imperative to create new eco-friendly lubricants is a significant concern. In recent times, vegetable oil-derived biolubricant base oil has emerged as a robust option for base oil. However, the availability of eco-friendly alternatives remains scarce. Despite ongoing developments, the widespread utilization of toxic organometallics such as ZDDPs (zinc dialkyldithiophosphates) remains prevalent as a multifunctional additive (MFA). In this view, a novel triazole-based multifunctional additive was synthesized via the reaction between 3-amino-1,2,4-triazole and dodecenylsuccinic anhydride (DDSA). Subsequent molecular characterization was evaluated using spectroscopic techniques such as FT-IR and NMR. Afterwards, the performance of the synthesized multifunctional additive was evaluated by blending this additive in polyol base oil in different concentrations ranging from 1000-4000 ppm. The anti-wear and anti-friction properties of the synthesized additives were evaluated via ASTM D4172B utilizing a four-ball test machine. Additionally, its anti-corrosion capability was evaluated following ASTM-G31 standards, while its anti-oxidant efficacy was determined using the DPPH (2,2-Diphenyl-1-picrylhydrazyl) radical scavenging method. The results revealed that the additive shows excellent anti-wear and anti-corrosion properties and moderate anti-friction and anti-oxidant properties. The optimum concentration of 1000 ppm demonstrated a notable reduction, with average wear scar diameter (AWS) decreasing to 0.614  $\mu\text{m}$  and the coefficient of friction decreasing to 0.1008, compared to the values of 1.047  $\mu\text{m}$  and 0.1143 respectively, for polyol base oil.

**Estimation of Trace Level Methanol in Fatty Acid Methyl Ester (FAME); Alternative of conventional EN14110 Method**

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**Abstract:**

Worldwide interest in alternative fuels has increased in the last decade. Fatty acid methyl esters (FAMES) provide an alternative to fossil fuel and it can be blended with petroleum diesel, domestic heating fuels or used as pure biodiesel (B100). Biodiesel is produced from vegetable oils or animal fats through transesterification using methanol to yield FAME and Glycerol. The yield, pure FAME (Once the Glycerol and the residual methanol have been recovered/ removed), is called B-100. Standard EN-14110 is an analytical method that uses a gas chromatograph (GC) with headspace to determine the amount of residual methanol in a mixture of FAMES ranges from 0.01% to 0.5% (m/m).

An alternative and simple analytical method has been developed for the quantitative estimation of residual methanol in biodiesel (B-100) using prefrac GC-FID. Prefrac GC-FID is able to back flush the heavier components of the sample (BP greater than 250 oC like Glycerol and its derivatives) and make the low boiling components available for analysis. Different biodiesel from vegetable oils and animal fats have been analyzed and the results are correlated with the standard EN 14110 method. Good correlation with EN 14110 method and PT sample (proficiency testing sample) analysis shows that the acceptability of the developed method is high. The new method is applicable for the concentration range from 0.005% (m/m) to 0.5% (m/m) of methanol in biodiesel which is a wider range than the EN-14110 method. Furthermore, the developed method provides better resolution between methanol and other low boiling components in Biodiesel than specified EN 14110 method. The specificity, linearity, accuracy and precision of the developed method have also been determined and indicate an appropriateness of the method. Conclusively, this developed method will be helpful for monitoring the methanol content in biodiesel and it able to replace the EN14110 method in practice.

**Keywords:** Biodiesel, EN-14110, Methanol estimation, Prefrac GC-FID, Method development, alternative of EN14110

## **Fabrication of A Low-Cost Portable Visible Spectrophotometer Using A Microcontroller and Triad Spectral Sensor**

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### **Abstract:**

Spectrophotometric applications in various scientific fields like chemistry, biology, environmental and materials science holds a great importance to understand the underlying science of materials in the presence of light. These various spectrophotometric techniques provide valuable insights of composition, concentration, and purity of materials. However, the high costs, bulky designs of the traditional spectrophotometers limit their accessibility in educational and field settings applications. Many research papers have recently reported that portable Arduino-based devices have low manufacturing costs, simple operations, and low power consumption to measure wavelengths for educational, analytical and research purposes on a customized basis.

In this study, we have fabricated an affordable and portable visible spectrophotometric solution. The developed spectrophotometer utilizes components such as the ESP8266NODE microcontroller, spectral triad sensor, COB white LED and a 12V LiPo battery which makes it suitable for educational and field applications. The pre-calibrated feature of the AS7265X triad spectral sensor in the spectrophotometer offers accurate and calibrated spectral measurements across 18 channels spanning 410 to 940nm. Additionally, using the ESP8266 NODEMCU microcontroller introduces several advantages, including low-voltage operation (3.3V), built-in Wi-Fi connectivity, and reduced complexity by eliminating the need for an external Bluetooth module. The effectiveness of the visible spectrophotometer is measured using potassium permanganate standards, and the results were compared to those of a commercial single-beam spectrophotometer. Its affordability, simplicity and innovative use of the ESP8266 microcontroller make it a valuable tool for researchers, educators, and professionals, paving the way for future innovations in spectroscopic research and instrumentation development.

### **Keywords:**

Low cost, portable Spectrophotometer, ESP8266 NODEMCU, AS7265X triad spectral sensor, COB-Chip On Board, LED- Light Emitting Device.

## **Advancing Sustainable Synthesis: Strategies for Commercially Significant Biobased Materials**

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### **Abstract:**

Biobased materials play a crucial role in sustainable growth, ensuring environmental protection for future generations. However, establishing biomaterials as viable alternatives to commercial counterparts presents significant challenges, particularly in achieving robust mechanical strength, scalability, and reproducibility for commercialization. Hence, this study emphasizes the importance of synthesizing commercially significant polymeric materials from biopolymers.

Our approach integrates  $\text{--COOH}$ ,  $\text{--N}^+(\text{CH}_3)_3$ , and  $\text{--SH}$  groups into biopolymers to propose progressive alternatives to traditional anion/cation resins, antimicrobials, and other products. However, ensuring uniformity and extensive modification in biopolymers is crucial for commercial viability. To address this, we propose reactions involving common laboratory reagents and simple-scalable procedures. For example, we employ a solvent-less synthesis utilizing sodium nitrite and acid as a source of nitrogen oxides as an oxidant to integrate  $\text{--COOH}$  groups into chitin, offering an alternative to high-cost hyaluronic acid, which is projected to reach a USD 2.6 billion market by 2030.

Another strategy involves activating the biopolymer with chloroacetyl chloride, followed by its reaction with reagents containing active groups such as choline chloride, citric acid, and thiourea. Our results demonstrate more than one degree of substitution through various analytical techniques, indicating the success of these strategies. Biopolymers modified with such a high content of active groups in great homogeneity and uniform morphology hold potential for diverse applications. Overall, this presentation will provide a robust evidence base and rationale for establishing these functionalized biopolymers as future alternative materials to commercial counterparts, advancing technology while promoting environmental sustainability.

**Trend of Changes in Physico-Chemical Parameters in Different Seasons in River Water: - A Review**

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**Abstract:**

River water is the essential component of the environment. Most of the population of the India depends on the water of the river for their various purposes. India is a country of the river and increase in population is the main reason of the drastic pollution in river. This review deals with the causes of the pollution in river water which affect physico-chemical characteristics of the river water at different stretches. The physical and chemical characteristics which have been studied are pH, turbidity, conductivity, acidity, alkalinity, total hardness, DO, BOD, COD, total dissolved solids etc. The effects of river water on the agriculture field have also been studied. The risk effect and trend of pollution were also study. The research on the river water is commonly studied on all polluted river. This study shows the seasonal variation (like in winter, summer, pre-monsoon, monsoon and post-monsoon) in various parameters of river water. Most of the parameters are the indicators of the pollution. The variations in Physico-Chemical parameters dependent on the accumulation of toxic components and hence disturb the aquatic ecosystem. This changes Water Quality Index (WQI). Thus this review gives the overview how the atmospheric conditions affect the water quality or their Physico- Chemical characteristics of river water. Keywords – Physical parameters, chemical parameters, river water, pollution, seasonal variation.

**Investigation of lubricity of Dimethylfuran blended with Gasoline**

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**Abstract:**

DMF has emerged as an alternative fuel due to its renewable nature and physicochemical properties. As research into sustainable energy resources intensifies, DMF has gained attention as a potential gasoline additive to improve the lubricity and performance of conventional fuel.

Lubricity analysis of the fuel is necessary because of the lubricating role of the fuel during the engine run. Many studies have been done in the area of lubricity considering diesel fuel. However, the lubricity of gasoline and alternative fuels has become significant due to the introduction of direct-injection gasoline fuel pumps with high injection pressure, which are closer to diesel pumps.

In the current study, a series of laboratory experiments were conducted to evaluate the lubricity properties of DMF-gasoline blend, i.e., DMF5G (5% 2, 5-Dimethylfuran, and 95% gasoline). A high-frequency reciprocating rig (HFRR) was employed to simulate real-world operating conditions and measure friction coefficient and wear scar diameter as key lubricity indicators. The results of the study contribute valuable insights into the use of DMF as a lubricity-improving agent for gasoline. The friction and wear scar diameter analysis revealed that adding 5% DMF to gasoline resulted in a smaller wear scar diameter than pure gasoline. The results indicate that DMF offers increased protection against friction and wear and can be used as an additive to gasoline to improve its lubricity.

Keywords- Lubricity, DMF, friction, wear

## **Going Green – The Behavioural Dimension**

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### **Abstract:**

Sustainable development is increasingly becoming much more than a topic to speak at seminars and conferences and a matter of urgent and critical concern for the global community as all stakeholders try to find ways and means to literally and figuratively “meet the needs of the present without compromising the ability of future generations to meet their own needs”.

It is therefore not surprising that individuals, institutions and countries are finding ways to do things that are less energy intensive and reduce carbon footprint. As organizations draw up their own enterprise level plans to meet net zero targets, bringing change in mindset is recognized as being the key to achieve long term sustainability.

At an enterprise level, ‘Green HRM’ is one more opportunity in terms of both structure and process to explore actions that can be taken to reduce carbon footprint and do what we have to do with the least harmful impact on the already threatened & fragile environment.

The Human Resource function has always had a critical role in building organizational culture. Given the right set of priorities, this can go a long way in sensitising the workforce about individual and enterprise carbon footprint and its harmful impact. It also has the responsibility to plan, prioritise and strategize organizational capability towards achieving sustainability and ensuring environment protection.

Most importantly, in terms of role & identity, the HR function in an organization is the ‘behavioural role model’ and hence it can and should provide management with much needed moral authority to do and act in a manner that spreads the message that in this organization, leaders, ‘walk the talk’.

This paper explores the options, strategies and possible outcomes of going Green by focusing on the behavioural dimension.

## **Ion Exchange Resins: Assessing Mechanical Strength for Enhanced Industrial Performance**

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### **Abstract:**

Ion exchange resins (IER) are synthetic polymers with a cross-linked three-dimensional structure, incorporating functional groups such as sulfonic acid. Typically, these resins are copolymers of styrene and divinylbenzene (DVB), forming spherical particles ranging from 300 to 1200  $\mu\text{m}$  in diameter. In petroleum refining, cation exchange resins are used as catalyst in the process for production of ethers like MTBE, ETBE, TAME, TAE as well as for dimerization of isobutylene. Standard test methods, outlined in D2187, evaluate the physical and chemical properties of ion exchange resins. While standard methods encompass assessments such as water retention capacity, particle size distribution, and total acid capacity, the assessment of their mechanical strength, particularly crushing strength, remains a challenge. Mechanical strength is vital for catalysts and absorbents in industrial applications, influencing their manufacturing, packaging, loading, and reactor performance. While conventional methods exist for determining the crushing strength of fixed bed catalysts which are mostly based on alumina or zeolite. These catalyst systems are being tested in Versatile Catalyst Crushing Strength Tester. This apparatus furnishes essential data including the catalyst sample diameter (both nominal and crushing diameter), crushing strength (in daN), crushing slope (in daN/mm), and applying force rate (in daN/s). However, testing of IER requires new approaches as the size distribution varies in the manufacturing process. The determination of the crushing strength of ion exchange resin holds paramount significance due to the potential for resin breakage during operation, leading to fine generation and reactor choking. At present the breakage tendency of the fresh catalyst will be known only after the 100 hrs of tedious performance evaluation test using actual feed. This leads to significant loss of time, material, manhours etc. To address these issues, it becomes imperative to ascertain the crushing strength of the catalyst prior to reactor loading. Different commercial grade Ion exchange resins are tested, and comparative assessments are conducted to juxtapose the crushing strength of various grades of ion exchange resin which will provide insights into their relative mechanical robustness and operational suitability. Such comparative analyses facilitate informed decision-making in catalyst preparation, reactor design, operation, and troubleshooting, thereby enhancing process efficiency and reliability. This paper discusses the results of experimental investigations undertaken to analyze the crushing strength of the catalyst across different mesh sizes and a methodology is developed to measure the crushing strength of Ion exchange resin based catalyst system.

**Keywords:** Ion Exchange resin, crushing strength, dimerization catalyst, cross linked polymer, etc.

## **Giant Enhancement in the Electrical Conductivity of Ti Doped N-Type ZrNiSn Based HH Matrix**

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### **Abstract:**

Thermoelectricity is a green energy technology, which could convert waste heat into electricity and thus also deal with the problem of global warming. Among the existing thermoelectric materials, ZrNiSn-based HH alloys have emerged as the most exciting contenders for mid temperature thermoelectric applications owing to their excellent stability, high mechanical strength, and moderate thermoelectric performance. A lot of efforts have been made to optimize the electronic and thermal transport of ZrNiSn alloys by employing various approaches. The aliovalent doping and off-stoichiometric compositional tuning approaches separately have been explored in ZrNiSn to enhance the overall thermoelectric performance. In the present study, we combinedly explore the doping and off-stoichiometric compositional tuning to improve the thermoelectric performance of n-type ZrNiSn-based HH alloy. To enhance the electronic transport properties, an aliovalent Nb-doped off-stoichiometric ZrNiSn based alloy (Zr<sub>0.97</sub>Nb<sub>0.03</sub>Ni<sub>1.04</sub>Sn) was developed. Further to reduce the thermal transport, mass, and strain field fluctuations were created in the system lattice by Ti-Zr alloying. The samples were characterized for microstructural and electronic transport properties, where the field emission scanning electron microscope (FESEM) reveals the presence of the minor Zr-rich secondary phase. The enhanced carrier density and present minor secondary phases lead to a giant enhancement in the electrical conductivity of Zr<sub>0.5</sub>Ti<sub>0.47</sub>Nb<sub>0.03</sub>Ni<sub>1.04</sub>Sn compared to pristine ZrNiSn. The reduction in thermal conductivity is further expected due to the generation of point defects by the alloying of Zr-Ti. \*Corresponding authors: bhasker@nplindia.org

## **Utilization of Linear Alpha Olefins (C9-C18) Derived from Coker Distillate To Develop Polymeric Bitumen Modifier**

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### **Abstract:**

Conventional and modified bitumens are currently the two types of bituminous binders which are being used in the construction of flexible pavements. Conventional bitumens are high temperature susceptible and thus cause failure due to its early aging. Asphalt/bitumen mixtures primarily experience two major failure mechanisms: cracking and rutting (permanent deformation). Many researchers have done tremendous work on polymermodified bitumens but are expensive and have settling problems with time and thus make two separate phases causing serious fretting on the roadside. In this study, in-situ polymerization of alpha olefins (present in coker feed) and styrene was conducted and the polymer was obtained. The synthesised polymer has been used to improve the bituminous properties in order to increase its temperature susceptibility and provide comparatively high strength in hot and arid climatic conditions. Viscosity grade VG10 and VG30 base bitumens were used to make modified bitumens. Both VG bitumens and synthesized modified bitumens were characterized for physico-chemical, rheological, and instrumental analysis. The synthesis of the additives was confirmed by FT-IR and NMR spectroscopy. Rheological studies showed improvement in the values of rutting resistance, complex modulus, loss modulus and storage modulus after blending of synthesized polymeric additive in VG 10 base bitumen. Study on multifunctional additives also revealed that the prepared modified bitumens marginally meet the properties of higher-grade VG and modified bitumen as per IS and IRC specifications. Keywords: Bitumen; polymer modified bitumen; rheology; rutting resistance; viscosity grade bitumen

**Synergistic Enhancement of Photo catalytic Degradation of Crystal Violet Dye Using an Iron-Based Metal-Organic Framework in Conjunction with H<sub>2</sub>O<sub>2</sub>**

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**Abstract:**

Metal-organic frameworks' unique chemical and physical properties make them a preferred choice for environmental cleanup. This article describes how diamond-shaped MIL-53(Fe) MOFs were synthesized using a solvothermal process. Powder XRD, FESEM-EDX, and FTIR were employed to determine the sample's structural properties. The band gap was determined using UV-visible spectroscopy and found to be 3.09 eV at 401 nm. Crystal violet (CV) dye was used to test the photo catalytic efficiency of Sample with H<sub>2</sub>O<sub>2</sub>. After 100 minutes of exposure to sunlight, the iron-based MIL-53-H<sub>2</sub>O<sub>2</sub> system demonstrated superior photo-catalytic degradation performance compared to the lack of H<sub>2</sub>O<sub>2</sub>. The CV clearance rate was 97.98%.

## Land Use Regression Modeling for Environmental Noise Prediction in Delhi City, India

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### **Abstract:**

Environmental noise pollution is a growing concern in urban areas worldwide. However, assessing exposure to environmental noise levels remains complex in conditions where no standardized noise prediction model is available. In the present study, LUR model has been developed to predict the environmental noise levels in Delhi city, India. The day and night equivalent noise levels were modelled at daily resolution by utilizing an annual dataset of noise levels from 31 locations in Delhi city. The noise monitored data was integrated with GIS features including land use, road networks, and meteorological parameters. The study also explored the influence of traffic congestion on noise levels. The developed LUR models showed good fit with  $R^2$  of 0.72 for  $L_{\text{day}}$  and 0.55 for  $L_{\text{night}}$ , which was further optimized using Neural Network approach up to  $R^2 = 0.80$  ( $L_{\text{day}}$ ) to 0.67 ( $L_{\text{night}}$ ). The transport variable derived from annual travel time data observed to be the most influential predictor of the model, which signifies the crucial influence of traffic congestion on environmental noise levels. This study offers a valuable tool for noise mitigation planning, particularly in regions lacking validated noise prediction models or traffic flow data. This study shall be helpful for policymakers to create quieter and healthier urban environments.

## **Comparative Water Quality Assessment of Indo-Nepal Transboundary River Gandak Using Multivariate Techniques**

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### **Abstract:**

The Sustainable Development Report 2022 indicates that only 32 countries have effectively managed 90 percent of their transboundary waters. The Gandak River is one such vital Indo-Nepal transboundary water body for millions of people from both nations. To my knowledge, this is the first water quality assessment on the Gandak River spanning from Nepal to Bihar, India. In this study, thirty sites along the river stretch were investigated for eleven physicochemical parameters: PH, Temperature, Electrical conductivity (EC), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Alkalinity, Nitrate (NO<sub>3</sub>), Phosphate (PO<sub>4</sub><sup>3-</sup>), Dissolved Oxygen (DO), Sodium and Potassium. The analytical results reveal high phosphate ( $1.19 \pm 1.08$ ) and low DO ( $2.6 \pm 4.7$ ) concentrations in the Bihar region, indicating potential eutrophication and poor aquatic health. A significant correlation ( $\geq 0.7$ ) was observed among EC, DO, Temp, and TDS, indicating the inter-dependency of the variables. Sites in the downstream of the river in the Bihar region showed signs of medium and poor water quality, while the upstream water quality of the river in the Nepal region mostly comprises within the permissible levels set by the Water Standards of India, the United Nations Economic Commission for Europe (UNECE), and the World Health Organization (WHO). Pollution peaks notably beyond Site 26, mostly attributed to industrial effluents from nearby industrial areas. The findings of this study emphasize the proactive, regular monitoring of Gandak River water for the integrity of aquatic flora, fauna, and human health.

Keywords – Water Pollution, Water Resource management, Water monitoring, Sustainable Management, Transboundary River

**One-Pot Synthesis of Nitriles Via the Sequential Addition of Hydroxylamine and Aldehydes with Benzoyl Chloride at Room Temperature**

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**Abstract:**

We have reported a base-mediated direct synthesis of diversely substituted nitriles via the sequential addition of hydroxylamine and benzoyl chloride with aldehydes. The transition-metal free approach at room temperature provides the advantage of simple operation, highly functional group tolerance, short reaction time and gram scale synthesis, showing the completion of the developed protocol. A wide range of aromatic as well as heteroaromatic aldehydes were consistent with the applied strategy. Diversified aromatic and aliphatic benzonitriles were accessed in good to excellent yield. Keywords: Benzaldehyde, Base-mediated, Transition-metal-free, Sequential addition, Benzoyl chloride

## **Saturated Absorption Spectroscopy of Ytterbium atomic beam**

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### **Abstract:**

At CSIR-NPL we are working towards building an optical frequency standard or optical atomic clock based on the interrogation of a single trapped and laser cooled Yb171+ ion. Yb171+ ions have two ultra narrow linewidth clock transitions, one is at  $\sim 435$  nm  $2S_{1/2} - 2D_{3/2}$  quadrupole transition and other is at  $\sim 467$  nm  $2S_{1/2} - 2F_{7/2}$  octupole transition. To trap the Yb ion first process is to ionise the Yb atom, for ionisation we use photoionization technique, in which laser is applied to atomic beam for ionisation. For two photon ionization of Yb atoms,  $1S_0 - 1P_1$  transition,  $\sim 398.9$  nm laser is used for excitation of atoms and then a laser  $>394$  nm (in our case we use 369 nm laser) is used for ionization. Hence  $1S_0 - 1P_1$  transition at  $\sim 398.9$  nm is very useful for isotope selective excitation of the Yb atoms. The spectroscopic studies of Yb are necessary to get the exact value of resonance frequency for its different isotopes. These precise values of frequencies then used for tuning the laser frequencies for isotope selective photo excitation or photoionization of Yb atoms. Saturated Absorption Spectroscopy (SAS) is a technique commonly used to record Doppler broadening free absorption spectra, to estimate the linewidth of the transition closer to natural linewidth of the atomic transition. Here in this present work, we have demonstrated various orientations of the laser beam with respect to the atomic beam to get a Doppler broadening free absorption signal. One such orientation is traditionally used counter propagating pump and probe laser beams, in which power broadening is one of the dominant factor. Whereas, in other orientation the pump and probe beams passed perpendicular to each other, this orientation is used to get a signal which have removed the effect of power broadening to a greater extent and does not follow the Saturation characteristics. Following these techniques transition frequencies for the  $1S_0 - 1P_1$  transition of Yb for different isotopes have been calculated. The transition frequency for Yb174 is estimated to be  $\sim 751526556.04(60)$  MHz with a linewidth of 32.08MHz. Keywords: -Doppler Broadening, Saturated Absorption Spectroscopy, Quantum Metrology, Optical Frequency standard.

**Pilot-Scale Optimization of Enhanced Biodiesel Production from High FFA *Podocarpus Falcatus* Oil Via Simultaneous Esterification and Transesterification Assisted By Zirconia-Supported ZSM-5**

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**Abstract:**

In this work, the catalytic activity of a zirconia nanocatalyst supported on the ZSM-5 zeolite (ZSM-5@ZrO<sub>2</sub>), which was produced and then thermally treated at three different temperatures (300, 500, and 700°C) was examined. The ZSM-5@ZrO<sub>2</sub> catalyst was analysed using TGA/DTA, EDX, FT-IR, MAS-NMR, XRD, BET, SEM, and XPS techniques to assess its textural characteristics, surface shape, crystallographic structure, surface functional groups, elementary composition, and thermal stability. The alcohol/PFO molar ratio, catalyst load, temperature, and reaction time were all optimised for biodiesel production using a central composite design approach. Due to its high activity for converting *Podocarpus falcatus* oil (PFO), the tetragonal ZSM-5@ZrO<sub>2</sub>-500 compound calcined at 500 °C was chosen as a representative catalyst. Under optimal conditions, with a methanol/PFO ratio of 18.67%, a catalytic load of 1.73%, a reaction temperature of 214.8°C and a response time of 4.48 h resulted in a maximum biodiesel efficiency of 91.88 ± 0.02%. FT-IR, NMR, and GC-MS analyses revealed that the biodiesel produced was rich in methyl esters. Additionally, ASTM D6751 standards are met by its physicochemical qualities. Additionally, the ZSM-5@ZrO<sub>2</sub>-500 catalyst was employed five times a row after regeneration.

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**Identification of Two Coumarin Glycoside from Leaves of *Skimmia Laureola* By The Concerted Use of 1D And 2D-NMR Spectroscopy**

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**Abstract:**

The leaves of *S. laureola* were collected from Nachiketa Tal (at an altitude of 2450-2500m), District Uttarkashi, Uttarkhand, India. The air-dried and powdered leaves of *S. laureola* were exhaustively defatted with light petroleum ether (60-80°). The petroleum free mass sequentially extracted with chloroform and n-butanol. The n-butanol layer was separated and concentrated under reduced pressure to give BuOH extract. The n-butanol extract on repeated column chromatography over Si-gel eluted with different proportion of chloroform, methanol afforded two coumarin glycosides. The coumarin glycosides are identified as 6-O-β-D-glucopyranoside-2H-1-benzopyran-2-one and 7-methoxy-6-[3'-O-β-D-glucopyraosyloxy-2'-hydroxy-3'-methylbutyl]-coumarin by the concerted use of 1D and 2D-NMR spectroscopy.

## **Stabilization of A Diode Laser Frequency to Atomic Transitions of Ytterbium Isotopes**

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### **Abstract:**

Naturally abundant Ytterbium (Yb) atoms have several isotopes but out of all those isotopes, <sup>171</sup>Yb has immense importance as it offers multiple narrow linewidth forbidden transition in the optical domain. Two such narrow linewidth transitions, i.e., quadrupole transition at ~ 435 nm and octupole transition at ~ 467 nm are popularly being used for developing optical frequency standard or optical atomic clocks.

To develop an optical clock, multiple number of lasers are utilized for the production and laser cooling of ions. However, the natural tendency of most used external cavity diode lasers (ECDL) is that their set output frequency always deviates due to any minor internal or external perturbation. So, it is very crucial for all precession spectroscopic measurement that the lasers output frequencies are stabilized to a reference frequency and for that a reliable atomic transition frequency as reference and a controller system are used. For efficient production of Yb ions and their laser cooling, atomic transition frequencies of Yb isotopes are the most ideal references for this purpose. The present work describes acquisition of desired reference frequencies from the saturation absorption spectroscopy (SAS) of Yb atoms, coming out from an effusive atomic oven. The error signal generated from the SAS of the Yb atoms is fed into a feedback control system to stabilize the operation frequency of the laser. Due to lower abundance of <sup>171</sup>Yb atoms, the corresponding SAS signal is too weak for efficient locking of the laser output frequency therefore we have used prominent <sup>174</sup>Yb transition as our reference for laser frequency stabilization. All isotopic transitions of the Yb atoms are very close to each other hence stabilizing laser frequency to any of the isotopic transition can be used as the reference and subsequently to calibrate a wavelength meter to lock multiple lasers through a multi-channel switch. Multiple number of laser frequencies have been stabilized for the two-photon ionization of Yb atoms as well as for laser cooling process for our ion trap experiment to develop an optical atomic clock at CSIR-NPL.

## Uranium Contamination Assessment in Water Samples Collected from Schools, Colleges and Hospitals

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### Abstract:

The environment has always included natural radioactivity since the formation of the Earth. If natural elements like uranium and its byproducts are present in groundwater excessively, they may cause health issues. Uranium-238 (99.284%), Uranium-235 (0.711%), and Uranium-234 (0.0055%) are the three isotopes of uranium. As per the World Bank report, India is the largest global user of groundwater. Over 230 cubic km of groundwater, or more than 25% of the world's total water supply, are used by it each year. Prior studies have highlighted the presence of elevated uranium concentration ions in groundwater and its potential health consequences. Numerous factors, including particle solubility, elimination methods, duration of exposure, and contact time, influence uranium toxicity. Humans primarily consume uranium from food (15%), water (85%), and the air (15%). Several additional studies have linked uranium (U)-contaminated drinking water to illnesses such as chronic renal disease and lung cancer. Uranium may influence a person in two different ways. The first is Stochastic, caused by ingesting 50–150 mg of uranium, and can result in renal failure. Another is non-stochastic, resulting from small doses of uranium (25 to 40 mg), and is marked by proteins and urine packed with dead cells. According to the India Today Report of 2018, a total of 12091 deaths in the state of Haryana were exclusively linked to different types of cancer. The present study was conducted with 40 water samples taken from borewells, RO water, and tap water from various schools, colleges, and hospitals of Gurugram City, Haryana, India. The LED fluorimetry method was used to determine the concentration of uranium. The observed value of uranium concentration ranged from 0.004 µg/L to 9.4 µg/L with a mean value of 2.6 µg/L. The results were compared with the recommended limit suggested by the World Health Organization and the Atomic Energy Regulatory Board (AERB), India. The annual effective dose, excess lifetime cancer risk, and hazard quotient were estimated from the results of uranium level in water samples. The chemical and radiological risk assessment results show no potential chemo-radiological impacts due to uranium contamination in the collected water samples.

**Keywords:** Uranium, Water samples, LED fluorimetry, Chemical toxicity, Annual effective dose.

**Molecularly Imprinted Polymer-based Plastic Antibodies for the Electrochemical Detection of Bisphenol-A: Robust and Economical Approach to Screen Environmentally Hazardous Substance**

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**Abstract:**

In response to the growing concern surrounding environmental pollutants, this study presents a novel electrochemical sensor designed to detect the endocrine-disrupting chemical, Bisphenol-A (BPA). BPA is a synthetic chemical widely used to produce plastics, epoxy resins, and other consumer goods. One of the major concerns associated with BPA exposure is its estrogenic effect, meaning that it can mimic or interfere with the action of the hormone estrogen in the body. The sensor employs a synergistic combination of graphene quantum dots (GQDs) and molecularly imprinted polymers (MIPs) to enhance the sensitivity and selectivity of BPA detection in environmental samples. In response to the growing concern surrounding environmental pollutants, this study presents a novel electrochemical sensor designed to detect the endocrine-disrupting chemical, BPA.

The electrochemical sensor's design capitalizes on the unique properties of GQDs, known for their exceptional conductivity and electrocatalytic activity. The molecularly imprinted polymer was tailored to selectively recognize and bind with BPA molecules, ensuring the sensor's specificity towards the target analyte. The fabrication process involved the synthesis of GQDs through green synthesis using starch as a precursor. The 3,4 ethylenedioxythiophene was selected as the monomer and the electropolymerization was performed on the surface of the glassy carbon electrode. The template BPA was electropolymerized along with the polymer. Post-polymerization, the template was extracted which leaves behind the cavities that are specific for BPA.

The proposed BPA sensor excels in analyzing complex environmental matrices, demonstrating its potential for practical use. Offering rapid response, low detection limits, and superior selectivity, it emerges as a valuable tool for monitoring BPA contamination. With a linear detection range of 1nM to 50μM, a low detection limit of 0.19 nM, and a quantification limit of 0.64nM, the sensor showcases remarkable electrochemical performance. It combines high selectivity, sensitivity, and the convenience of reusable electrodes for BPA detection. The recovery rate, ranging from 95-112%, attests to the reliability of the sensor, successfully applied for real sample analysis. This study significantly advances electrochemical sensors, particularly in tackling the challenges associated with monitoring BPA—a prevalent environmental contaminant with known health implications.

## **An Universal Acousto-Optic Modulator (AOM) Driver for Precision Spectroscopic Experiments**

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### **Abstract:**

Acousto-optic modulator (AOM) finds widespread applications in various fields such as spectroscopy, laser processing, and optical signal processing. AOMs allow precise tuning of the laser frequency with megahertz resolution or less required for precision spectroscopy. An acousto-optic modulator is driven by radiofrequency voltage which in turn generates acoustic waves in a special crystal with same frequency as the driving radiofrequency ( $\nu$ ) due to piezoelectric effect. Laser passing through this crystal is frequency modulated generating the sidebands around the fundamental laser frequency ( $\nu_0$ ) which decreases in the intensity with the increase of modulation order. In complex optical experiments such as optical frequency standards, multiple lasers are employed to carry out the experimental operation and hence requires multiple AOMs for getting precise frequency output from the lasers. AOMs are also used in experiments requiring very fast switching of laser beams (ON/OFF) which makes the computer control using programs indispensable. Therefore, it is highly desirable that these AOM drivers must be computer-controlled to reduce the complexity of the experiment and the execution time by providing a quick remote control.

At CSIR-National Physical Laboratory, we are developing an Optical Atomic Clock based on trapping a single ion ( $^{171}\text{Yb}^+$ ) whose operation involves the interaction of multiple lasers with the neutral Yb atoms and ions for the purpose photoionization, laser-cooling and repumping of metastable states, clock transition spectroscopy. The optical setup includes multiple AOMs for fine tuning of the laser frequency to perform spectroscopic experiments as mentioned above. This makes the AOMs and their drivers a critical component of the experimental setup. The present work reports about our efforts towards developing computer controlled AOM drivers, enabling the AOMs to be controlled from a computer without inclusion additional hardware installed to the controlling computer. This essentially requires designing an electronic circuit for frequency synthesization in the required range (150 – 250 MHz), a command and control module which includes a microcontroller, and a computer program that takes input from user and sends commands. The command unit that includes DAC and a microcontroller (Arduino Uno R3) is used for controlling the frequency synthesization unit. This work presents present the testing and calibration of frequency synthesization unit and the initial results of the tested command unit demonstrating its efficiency in controlling the synthesization unit.

**Utilizing Nanoparticles in Micropropagation for the Conservation of *Fumaria Indica***

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**Abstract:**

*Fumaria indica* is a species of the Papaveraceae/Fumariaceae family and is a delicate annual herbaceous plant native to regions of Asia, including India. *Fumaria indica* is a weedy plant species historically revered for its medicinal properties. It is an aromatic and edible plant. *Fumaria indica* is in the endangered category because of pesticides and fertilizer. In recent years, its population has decreased by more than 50%. Micropropagation is a procedure of growing plants in vitro under controlled conditions, generally in nutritional media. Contamination, whether or not from bacteria or contaminants like heavy metals, slows development. Nanoparticles, like silver nanoparticles (AgNPs), offer a solution. Adding AgNPs to the growth medium (Murashige and Skoog medium) along with BAP (phenylamine purine) and NAA (naphthalene acetic acid) derivatives of cytokinin and auxin hormones is supportive in preventing microbial contamination without harming the plants. Nanoparticles provide versatile solutions for contamination issues in micropropagation.

## Single-atom Cu doped TiO<sub>2</sub> photocatalyst for Photocatalytic Hydrogen Generation

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### Abstract:

Photocatalytic H<sub>2</sub> production provides one of the most viable solutions for sustainable energy generation and environmental remediation. Since their first report in 2011 by Zhang et al., single atom catalysts (SACs) involving single metal atom trapped on supports have attracted considerable attention for photocatalytic H<sub>2</sub> production due to their unique electronic structures and unsaturated coordination sites resulting in tremendously high activity and selectivity. Here, we developed a highly dispersed Copper single atom doped TiO<sub>2</sub> (CuSAT) catalyst by strategically trapping CuSA into Ti sites in TiO<sub>2</sub>, which exhibited unprecedented H<sub>2</sub> production rates of 3.3 mmol h<sup>-1</sup> g<sup>-1</sup> under simulated solar light irradiation in pure water. Experimental results and density functional theory (DFT) calculations showed that CuSA specifically replaced Ti atoms, inducing the creation of oxygen vacancies (Ov) in the CuSAT catalyst. It is revealed that CuSA doping played several crucial roles: (i) enhancing light absorption, charge transfer dynamics, and redox capability of photoexcited electrons; (ii) improving H<sub>2</sub>O molecule adsorption; (iii) facilitating electron transfer from CuSAT to H<sub>2</sub>O molecules; and (iv) shifting the d-band center closer to the Fermi level, thereby improving intermediate adsorption, resulting in approximately 100-fold enhanced H<sub>2</sub> production compared to pure anatase TiO<sub>2</sub>.

## **Green-Synthesized Carbon Quantum Dots and Their Application in The Degradation of Malachite Green Dye**

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### **Abstract:**

Carbon quantum dots (CQDs) have garnered significant attention due to their unique properties and versatile applications, particularly in environmental remediation. In this study, nitrogen-doped CQDs derived from plant leaves were synthesized via a facile microwave method. The incorporation of nitrogen atoms into the carbon matrix enhances the electronic properties and surface functionalities of CQDs, making them suitable for photocatalytic applications. The synthesized nitrogen-doped CQDs were characterized using various analytical techniques including XRD, FTIR, and UV-visible spectroscopy. The results confirmed the successful synthesis of CQDs with uniform size distribution, high nitrogen doping efficiency, and strong absorption in the visible range. Furthermore, the catalytic activity of nitrogen-doped sesame-based CQDs was evaluated for malachite green (MG) degradation, a toxic dye widely used in textile industries. The degradation efficiency was significantly enhanced in the presence of nitrogen-doped CQDs under sunlight irradiation. The nitrogen-doped CQDs demonstrated excellent stability and reusability, indicating their potential as efficient and sustainable photocatalysts for environmental remediation applications. This study highlights the promising prospects of utilizing plant-derived carbon materials to develop eco-friendly photocatalysts for water purification and wastewater treatment.

## Upcycling End-of-Life Solar Panel Waste into Self-cleaning Coating Compositions

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### Abstract:

The accumulation of atmospheric particulate matter on photovoltaic (PV) modules and the burgeoning challenge of managing end-of-life (EoL) waste streams generated by PVs constitute two prominent global issues confronting the scientific community. These concerns substantially influence operational efficiency and the broader environmental sustainability of solar energy systems. Herein, we have adopted a ‘*waste-to-wealth*’ strategy to upcycle the end-of-life solar panels and designed self-cleaning coatings from recovered oxide-based nanoparticles (e.g., silica). These oxides and their functionalized forms were characterized by structural, morphological, and wettability characteristics using X-ray diffraction, FTIR spectroscopy, scanning electron microscopy, and water contact angle. Finally, the modified nanoparticles were loaded in the polymeric matrix to form coating compositions, and the formed coatings over glass were demonstrated for water-driven efficient self-cleaning action, with applicability in wide areas including the domestic, commercial, space, and defence sectors in the form of self-cleaning surfaces including cover glass of solar panels.

**Keywords:** PV Waste, Upcycling, Silica Nanoparticles, Water contact angle, Self-cleaning coatings, Solar Panels

## **Green synthesis of Carbon Quantum dots from Bougainvillea Plant Extract for Potential Application in Supercapacitor**

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### **Abstract:**

Carbon quantum dots (CQDs) have emerged as promising candidates for various technological applications due to their small size, electrical, and chemical properties. In this study, we used a green and sustainable approach for the synthesis of carbon quantum dots using Bougainvillea plant extract as a precursor. We synthesized CQDs by hydrothermal method from flowers of Bougainvillea plant. We performed uv-vis spectra, FTIR, and XRD for the characterization of the CQDs. Furthermore, the CQDs were used as electrode materials for supercapacitor structure and characterized by CV, GCD, and EIS techniques. The results demonstrate excellent electrochemical properties, including high specific capacitance, good cyclic stability, and remarkable rate capability, making them promising candidates for energy storage devices. Overall, the green synthesis of carbon quantum dots from Bougainvillea plant extract presents a sustainable and efficient route for the development of eco-friendly energy storage materials with potential applications in supercapacitors

**Keywords:** Carbon quantum dots, Supercapacitor, specific capacitance, Green synthesis.

## Optimizing Brake Fluid Performance by studying Rheological Behavior on incorporating TiO<sub>2</sub> Nano-Additives

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### Abstract:

Specific rheological properties for a car's fluids, particularly brake fluids, are determined by operating and energy-efficiency criteria. With the help of a rotatable cone plate rheometer, this work's objective was to determine the rheological characteristics of both pure and nano-enhanced brake fluid. Titanium dioxide nanoparticles were coated with a surfactant to increase dispersion stability. The characteristics of coated nanoparticles were assessed by UV-Vis spectroscopy, photoluminescence, and XRD. We looked at the impact of adding Titanium dioxide nanoparticles to braking fluid at weights of 0.5%, 1.0%, 1.5%, and 2%. From 30°C to 120°C, the viscosity and flow curves of the brake fluid were measured. The results of the experiments revealed differences between pure and nano-enhanced brake fluids. The viscosity was constant across the whole shear rate range. Furthermore, viscosity decreased with increasing temperature. Overall, nanoparticle additions appear to increase viscosity. Both pure and nano-enhanced braking fluids showed a direct (linear variation) relationship between shear stress and shear rate. The relationship allows both pure and nano-enhanced brake fluids to be classified as Newtonian liquids. All samples obey Reynolds equation  $\mu_0 = be^{-\alpha T^A}$ . The behavior of the samples can be predicted by using Herschel-Bulkley model. Nanoparticles can replace classical additives or be complementary additives.

**Cultivation of Microalgae for Sustainable Dairy Wastewater Treatment and Carotenoid Synthesis.**

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**Abstract:**

Water pollution has significant adverse effects on the ecosystem, resulting in detrimental effect on human health and food security. Moreover, it significantly affects aquatic habitats, leading to phenomena like eutrophication and overall degradation of water quality. With an estimated 2.5 to 3 liters of wastewater produced for each liter of processed milk, the dairy industry is one of the main causes of water pollution among the various other contributors. The production of dairy products such as curd, butter, dry milk powder, cheese, and yogurt involves multiple stages, including milk processing, cooling, and equipment washing, all of which consume substantial amounts of water. Utilizing this dairy wastewater for microalgae cultivation presents a promising option for both wastewater treatment and resource recovery. Hence, the present study was carried out to cultivate different microalgae using dairy industry waste water. The experiments were carried out in conical flasks under outdoor condition. The biomass growth rate and pollutant removal efficiencies of microalgae species were compared. Furthermore, the carotenoid accumulation of different species was determined. The results revealed that microalgae have shown good removal efficiencies of pollutants along with high amount of carotenoids accumulation in algal biomass. Such technological aspects would contribute in achieving sustainability development goals (SDGs) (3,6,13,14) being a zero waste technology (ZWT) with zero liquid discharge (ZLD).

**Keywords:** Dairy waste water, Eutrophication, Microalgae, Carotenoids.

## **An efficient Radiofrequency (RF) Voltage Delivery System for the Development of Trapped-Ion Optical Atomic Clock**

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### **Abstract:**

The technique of trapping and laser cooling of a single ion in ultra-high vacuum (UHV) condition is one of the remarkable milestones in modern science and being utilized as the building blocks for many path breaking technologies, e.g., quantum computers, optical frequency standards, precision mass spectroscopy, etc. Trapping a single ion and interrogating its highly forbidden optical transition using ultra narrow linewidth laser can serve as a reference frequency to develop precise and ultra-stable optical clocks. At CSIR-NPL, work in progress towards developing such an optical clock based on probing the highly forbidden transition of a single Ytterbium ( $^{171}\text{Yb}^+$ ) ion within a quadruple radiofrequency (RF) ion trap. To build a trapped ion optical atomic clock, a radiofrequency (5 – 50 MHz) high-amplitude RF voltage (0.5 - 1 kV) is required to be transferred to a quadruple ion-trap in order to trap the ion and perform other steps involving multiple laser-ion interactions. Due to instabilities of such high amplitude radiofrequency potential, the system needs to be stabilized and the power delivery must be optimized. Delivery of high voltage RF to the trap electrodes is usually done through a helical resonator as it allows efficient power transfer with very high-quality factor (Q) through impedance matching. Resonant frequency of a helical resonator at loaded condition, i.e., when connected to an ion trap, is very much sensitive to external perturbation and the power transfer efficiency of the resonator is affected by movement of any conducting or inductive element near to the resonator. The present work reports about a technique for efficient delivery of high voltage RF to the trap electrodes through continuous monitoring of the drift of the resonant frequency of a helical resonator due to ambient variation and accordingly tuning the RF source frequency that it operates at resonant frequency. The reflected RF signal from ion trap is monitored and used as the feedback control for tuning the source to the resonant frequency of the helical resonator and eventually optimizing efficiency of power transfer of the helical resonator.

## **Integrated Biorefinery Approach for Wastewater Reclamation and Sustainable Biofuel Production from Microalgae: A Zero-Waste Concept for Circular Bioeconomy**

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### **Abstract:**

Currently, the two significant global challenges i.e., energy crisis and global warming can be solved by renewable alternative biofuels. Biofuels derived from algal biomass, such as bio-oil and biogas, are alternative sources of renewable energy that have gained much attention in recent years. However, the key issue with biofuel from algal biomass is its high production cost. Hence, in order to minimize the fuel production cost, strategies in which several value-added products with commercial potential are extracted from microalgae are discussed. Phytoremediation of sewage water by *Scenedesmus abundans* was integrated with bio-oil and biogas production for economic sustainability of biorefinery. Sewage water was treated in open raceway pond of 10000 L capacity and the removal efficiency of COD, BOD, nitrate, ammonia and sulfate was 72.2%, 23.5%, 83.33%, 66.66% and 50% respectively. Further, the harvested algae were subjected to hydrothermal liquefaction (HTL) reactor of 50 L volume for bio-oil production. A bio-oil yield of 30.15% was obtained with an HHV of 41.72 MJ/kg. The compounds in bio-oil fall into the diesel and gasoline spectrum. In addition, the biochar produced from HTL along with other biodegradable wastes were co-digested in 40 m<sup>3</sup> continuous stirred tank reactor (CSTR) for biogas production. The biogas yield of 7 m<sup>3</sup> per day was achieved for an HRT of 30 days. The third-generation algal biomass has the potential to bio-capture carbon dioxide and provide clean energy along with various products to achieve United Nations sustainable developmental goals (SDGs), especially SDG-6, 7, 11, and 13.

**Keywords:** Sewage water, *Scenedesmus abundans*, Hydrothermal Liquefaction, Bio-oil, Biogas, Waste management

## **Exploring CO<sub>2</sub> Foam Stability in High-Pressure, Low-Temperature Hydrate Reservoir Conditions**

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### **Abstract:**

CO<sub>2</sub> foam flooding has proven to be a potential method for enhancing methane recovery from natural gas hydrates as well as oil recovery from hydrocarbon reserves. Its efficiency lies in effectively controlling mobility and blocking high permeability channels during CO<sub>2</sub> flooding operations in the reservoir for oil and gas recovery. However, CO<sub>2</sub> foams exhibit lower stability due to the specific properties of CO<sub>2</sub>, such as lower viscosity. Hence, the careful selection of surfactants and their concentration as foaming agents becomes crucial for optimal foam performance, especially under harsh reservoir conditions. While studies have explored CO<sub>2</sub> foam stability under high pressure and high-temperature conditions for enhanced oil recovery, there's a noticeable gap concerning its stability study under high pressure and low-temperature conditions, pertinent to methane recovery from natural gas hydrate reservoirs by the exchange of CH<sub>4</sub> and CO<sub>2</sub>. Addressing this gap could significantly advance our understanding and utilization of CO<sub>2</sub> foam for methane recovery applications from natural gas hydrates and sequestration of CO<sub>2</sub>. This study investigates the performance of various anionic, cationic, and non-ionic surfactants in producing stable CO<sub>2</sub> foam, alongside examining the suitable concentration of surfactant for foam production. To evaluate foam stability, experiments utilize a high-pressure cell with a viewing chamber setup, aiming to identify the optimal surfactant concentration for achieving enhanced stability in the CO<sub>2</sub> foam system. Testing occurs under differing conditions, including high pressure and low temperature, as well as atmospheric pressure and room temperature, facilitating comparison of their effects on foam stability. The objective is to assess surfactants effectiveness and determine the appropriate concentration necessary to stabilize foam structures, a crucial factor for various applications like methane recovery from natural gas hydrates.

**Keywords:** Surfactants, CO<sub>2</sub> Foam, Gas Hydrate

**Enhancing Microfossil Analysis Through Coated and Uncoated FE-SEM Methods: Insights from Neo-Tethys of NE Himalaya**

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**Abstract:**

Field Emission Scanning Electron Microscopy (FE-SEM) is a powerful tool for the examination of microfossils, offering high-resolution imaging capabilities that aid in the detailed analysis of these microscopic structures. This study explores the application of FE-SEM in analyzing microfossils through both coated and uncoated methods. The use of a conductive coating enhances image quality and resolution, allowing for a clearer visualization of fine surface features on microfossils. Conversely, the uncoated method provides a means to observe natural surface textures and compositions of microfossils. The research highlights the significance of the uncoated method in specific scenarios where microfossil abundances are minimal, such as in the context of foraminifera in the NE Himalayan Neo-Tethys sequence. In such cases, the uncoated method proves to be particularly valuable, enabling researchers to study and identify microfossils effectively despite their low abundances. This study summarizes the methodology and benefits of utilizing FE-SEM for the examination of microfossils, emphasizing the importance of the uncoated method in enhancing the understanding of microfossil assemblages in regions with limited fossil concentrations.

*Keywords: Composition, Fe-SEM, Foraminifera, Microfossils, Structures*

## **Unveiling Pesticide Residue Profiles in Fruits and Vegetables: A Comprehensive Study in Rajkot District, Gujarat**

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### **Abstract:**

Pesticides, while essential for pest control in agriculture, pose serious threats to human health and the environment. Accumulation of pesticide residues in water sources and food items is a growing concern globally. Studies conducted in different regions of India reveal high concentrations of organochlorine and organophosphorus pesticides in surface and ground water, indicating widespread contamination. Continuous exposure to contaminated water and food can lead to severe health complications, including glucose intolerance, lipid metabolism disorders, insulin resistance and acute toxicity to chronic health conditions such as cancer, neurotoxicity, and endocrine disruption. The indiscriminate use of pesticides, coupled with their persistence and bioaccumulation properties, contributes to their widespread presence in various environmental compartments. Despite regulations and bans on certain pesticides, their prevalence remains a challenge, particularly in water sources. Monitoring and assessing pesticide residues in food and water are crucial steps in safeguarding public health and mitigating environmental degradation. In this study, we assessed the presence of pesticide residues in fruits and vegetables obtained from various local vendors of Rajkot district, Gujarat, using sophisticated techniques such as Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) and Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS) methods. Page 2 of 2 Adhering to established protocol namely QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) for pesticides extraction and employing FSSR (Food Safety and Standard Regulation), 2011 from FSSAI (Food Safety and Standards Authority of India). The method for pesticides profiling in Fruit & Vegetables has been developed and validated as per guidelines delineated by the European Commission's SANTE Directorate (11312/2021). This method can identify and quantifying more than 160 consortium pesticides. Different pesticides from 150+ Fruit & Vegetable samples have been identified & quantified by using aforesaid validated method to provide a comprehensive understanding of residual pesticide level in the local food supply chain of Rajkot District, Gujarat, India

**Keywords:** Pesticides residue, Fruit, Vegetable, FSSAI, LC-MS/MS, GC-MS/MS, QuEChERS, SANTE.

## **Geothermal Prospect Identification in Uttarakhand**

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### **Abstract:**

As a renewable and sustainable energy source, geothermal energy has a lot of potential to diversify India's energy mix and lessen its reliance on fossil fuels. The objective of this poster is to present a thorough analysis of the state of geothermal energy prospect exploration and exploitation in Uttarakhand, emphasising significant advancements, and obstacles. The first section of the assessment covers the State's geological structure and highlights places with the potential for geothermal energy, such as those with strong heat flow and tectonic activity. It looks at previous and current geothermal exploration projects, , exploratory drilling, and geological surveys. In addition, we have examined the technical developments and improvements in geothermal research methods, including geochemical analysis, and remote sensing, which have made it easier to identify potential geothermal resources. The assessment assesses the utilisation of current geothermal projects in India, encompassing both energies generating initiatives and direct-use applications. It uses information from case studies and project reviews to evaluate the technical viability, financial viability, and environmental issues related to the use of geothermal energy. The obstacles that are impeding the extensive implementation of geothermal energy in the state are also discussed. These include uncertainty related to resource characterisation, drilling hazards, financial limitations, and regulatory restrictions. In order to hasten the development of geothermal energy in Uttarakhand, the study ends by presenting future research paths and strategic priorities.

Keywords : Geothermal energy , Review, Assessment, Uttarakhand.

## Self-Powered, Wide Spectral UV Response Out-of-Plane Photodetector Based on ZnO/Porous Silicon Heterostructure

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### Abstract:

**Introduction:** Silicon (Si) being an indirect band gap material, suffers from low absorption efficiency, heat generation through nonradiative recombination, and high thermal noise. Due to this silicon-based photodetector (PD) suffers from slow response and is inappropriate for use in LED manufacturing. Porous silicon (p-Si) is one such candidate that overcomes these shortcomings. Due to its large surface area, high surface free energy, and etching-induced surface states, p-Si interacts with several materials like biological, chemical, and optically active materials enhancing their properties and bringing new interface physics. Compared to in-plane configuration, photodetectors fabricated in out-of-plane configuration have the advantage of a large area of exposure and higher absorption coefficient resulting in higher sensitivity and responsivity. ZnO having a wide band gap of ~3.37 eV and large exciton binding energy of ~ 60 meV, facilitates efficient charge transfer processes with excellent electron mobility and the wurtzite lattice being the most thermodynamically stable and favorable phase for electronics applications. In this work, the photoresponse of the ZnO/porous silicon (p-Si) heterojunction is studied in an out-of-plane contact configuration. p-Si substrate is fabricated by anodic etching followed by the electrochemical deposition of ZnO NR film, forming ZnO/p-Si heterojunction.

**Results:** UV-Vis absorbance spectrum shows a broad absorption for wavelengths from 230 to 380 nm. The PL emission shows two narrow and prominent electron transition peaks at 263 and 383 nm and a peak of ~ 550 nm corresponding to defects. The 263 nm wavelength responsivity of the photodetector from UV-Vis and PL data suggests the presence of a defective SiO<sub>x</sub> as an intermediate layer between ZnO and p-Si. The photodetector is measured for its spectral selectivity and responsivity for both 266 and 370 nm. Under self-powered conditions, the device shows a low dark current of a few nA and enhancement of ~100 nA and ~1.37  $\mu$ A for both wavelengths. A responsivity of 527 mA/W and 10.5  $\mu$ A/W and detectivity of  $2.5 \times 10^{10}$  and  $2.9 \times 10^7$  Jones at 1V bias under 266 and 370 nm UV illumination are observed. The fast rise/decay time of 67/65 ms and 29/18 ms is observed for the self-powered condition of the device under both wavelengths respectively.

**Keywords:** porous silicon, zinc oxide, self-powered, UV photodetector, tunneling, oxygen deficiency centers, heterojunction.

**Non-trivial Band Topology in Metalloids AuSn<sub>4</sub>, PdSn<sub>4</sub> and Pb<sub>2</sub>Pd: A First Principle Study**

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**Abstract:**

Topological semimetals such as Weyl or Dirac semimetals with superconductivity have emerged as a new class of topological materials to realize and study Majorana Fermion. Here we use first principle methods to analyze the electronic band structures of intermetallic homologous compounds AuSn<sub>4</sub> and PdSn<sub>4</sub>, which crystallize in orthorhombic lattices. While both compounds share similar structures, PXRD indicates a preference for different space groups. AuSn<sub>4</sub> is a 2D superconductor whereas PdSn<sub>4</sub> is not. The electronic properties near the Fermi level arise mainly from transition metal d-orbitals and Sn p orbitals, rendering both compounds semi-metallic with Dirac type-I nodes. Despite Spin-Orbit Coupling (SOC) seeming mild, it effectively removes line degeneracy. Z<sub>2</sub> invariant calculations confirm weak non-trivial band topology, with distinct phases observed in AuSn<sub>4</sub>. PdSn<sub>4</sub> displays parabolic band dispersion, suggestive of heavy fermions described by the Dirac Hamiltonian, along with topological edge states near the G point. Magneto-transport measurements demonstrate non-saturating linear magnetoresistance, affirming the topological nature of both semimetals. The Pb<sub>2</sub>Pd crystallizes into a tetragonal structure. The topological non-trivial character of Pb<sub>2</sub>Pd is evidenced through bulk electronic band structure and Z<sub>2</sub> invariants, which are calculated within the protocols of density functional theory. The surface states spectrum of Pb<sub>2</sub>Pd is also studied, which further claims Pb<sub>2</sub>Pd to have a topological non-trivial band structure.

**Keywords:** Topological surface states, Density functional theory, Superconductors, Weak antilocalization, Z<sub>2</sub> invariant.

## **Nanoparticle Mediated Shoot and Root Elongation in *Boerhavia Diffusa*: Unveiling Growth Potential During in Vitro Cultivation**

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### **Abstract:**

*Boerhavia diffusa*, commonly known as "Punarnava" is a flowering herbal plant within the Nyctaginaceae family, renowned for its medicinal properties. Throughout history, various parts of this plant, including its aerial parts or roots, have been utilized across different medicinal traditions such as Ayurveda and Unani, for treating a diverse array of ailments in both humans and animals. The plant's pharmacological significance is further enhanced by its diverse chemical constituents, making it a sought-after resource for pharmaceutical industries. However, this popularity has led to detrimental consequences, including over exploitation and habitat degradation. To address this concern, the *in vitro* regeneration technique emerges as a promising approach for the conservation of *Boerhavia diffusa*. This paper explores avenues for regenerating and enhancing the yield of *Boerhavia diffusa* by investigating the impacts of different concentrations of plant growth regulators and adjuvants. The best shoot growth was observed in Murashige and Skoog (MS) media when supplemented with Kinetin at a concentration of 4.5 mg/L. The effect of adjuvants like coconut water and peptone was seen during shoot initiation of *Boerhavia diffusa*. Coconut water, serving as a natural cytokinin, significantly enhanced shoot growth when used at a concentration of 20%. The Root initiating hormones (auxins) when used at a very low concentration increased the shoot length. The effect of some Nanoparticles like silver, Zinc and Titanium was also observed in shoot initiation of *Boerhavia diffusa*. The optimal root formation occurred with the addition of 0.5 mg/L Indole-3-butyric acid (IBA) to the half strength MS media. Root elongation was facilitated through a hydroponic setup, followed by acclimatization in a 1:1 mixture of soil and sand. Around 90% of the plants survived through this process of tissue culture, leading to a considerable reduction in the overall growth duration when compared to the conventional external conditions. Thus, *in vitro* regeneration of *Boerhavia diffusa* presents a promising approach for its conservation, preservation and yield enhancement.

## **Laser Molecular Beam Epitaxy of Vertically Self-Aligned GaN Nanorod Array on Flexible Metal Foil and Their Applications**

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### **Abstract:**

Group III-Nitrides are ideal materials for the fabrication of optoelectronic and high-power devices due to their direct, wide and tunable bandgap, low electron affinity, high thermal stability, higher breakdown field and inherent polarization properties. Low dimensional structures such as nanowalls, nanorods or nanowires of group III-Nitride semiconductors exhibit improved physical, electrical and optical properties as compared to their bulk. One dimensional GaN nanostructures have been grown on conventional single crystalline substrates such as sapphire, Si and SiC. Now a days, flexible metal foils have become attractive for the growth of III-nitrides due to their lower-cost, high thermal and electrical conductivity, enhanced photon-harvesting, ease of fabrication and scalability. But high temperature growth techniques like conventional MBE and MOCVD, are not suitable for the growth of GaN as it severely degrades the epilayer quality and thus the device performance. In laser MBE technique, growth temperature can be reduced as the kinetic energy is supplied to precursors directly in the form of laser energy.

The direct growth of vertically self-aligned, single crystalline GaN nanostructure array is achieved on flexible Ta metal foil using LMBE technique by the laser ablation of GaN solid target under r.f. nitrogen plasma. The nanorods (NRs) grow over a large area with high areal density. The role of growth temperature, laser repetition rate and Ta foil pre-nitridation condition on the formation and properties of GaN nanorods have been studied. The grown GaN nanorod array exhibits excellent optical emission properties with a narrow near band edge emission at 3.4 eV as characterized by room temperature photoluminescence. The dense ( $1\text{--}2 \times 10^{10} \text{ cm}^{-2}$ ) GaN NRs were grown on bare Ta foil at growth temperature of 700 °C and laser frequency of 20Hz, with length and diameter of ~300 nm and ~70 to 90nm respectively. The nanorod density could be controlled through the nitridation of Ta foil substrate before GaN growth. We have employed this structure for field emission properties and due to geometrical configurations of nanorods and their good crystalline quality, it showed excellent field emission performance with turn on field and field enhancement factor of 2.73 V/ $\mu\text{m}$  and 1899 respectively. The growth mechanism, properties and application of GaN nanorod ensemble will be discussed in detail.

## Antimicrobial and Antioxidant Activity of Herbal Based Mosquito Repellent Essential oils

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### Abstract:

In this study, antimicrobial and antioxidant activity of the extracted essential oils of lemongrass (*Cymbopogon citratus*) and Eucalyptus (*Eucalyptus globulus*) leaves were investigated for developing effective and eco-friendly antimicrobial mosquito repellent. Essential oils (EOs) were isolated by hydro distillation through Clevenger apparatus from dried leaves of selected plants. Physical and chemical characterization i.e pH, colour, odour, solubility, saponification, acid, ester value and free fatty acid percentage were analyzed respectively using the standard methods. Extracted EOs were characterized by GC-MS techniques. The antioxidant activity of EOs (Lemongrass and Eucalyptus) was assessed by DPPH assay using ascorbic acid as the standard. Antimicrobial assay of EOs was performed by the agar well diffusion method in Muller Hinton Agar plates against Gram- positive (*Staphylococcus aureus*) and Gram-negative (*Escherichia coli*) bacteria. The test organisms were inoculated in Muller Hinton Broth and incubated at 37 °C to adjust the turbidity to 0.5 McFarland standard giving a final inoculum of  $1.5 \times 10^8$ , Gentamicin was used as reference. Extraction yield of EOs of Lemongrass and Eucalyptus leaves were 0.6 % and 1 % respectively. Lemongrass showed higher antioxidant activity than Eucalyptus. Eucalyptus EOs showed highest antimicrobial activity against *Escherichia coli* and Lemongrass EOs against *Staphylococcus aureus*. Major constituents were found in Eucalyptus EOs Eucalyptol,  $\beta$ -terpineol  $\alpha$ -terpineol, 1,8 cineol,  $\gamma$ -terpinene, D-limonene and in Lemongrass EOs geranial, z-citral,  $\alpha$ -linalool, camphene. On the basis of obtained results, we can use both of oils for the preparation of Herbal based mosquito repellent instead of Chemical based repellent.

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**Geothermal Favourability Investigations along the Central Indian Tectonic Zone Using Multi-Categorical Data Analysis (MCDA)**

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**Abstract:**

Geothermal energy has recently seen a spike in usage as a viable and ecologically sustainable solution to meet India's growing energy demands. There is a lot of geothermal energy in India's Central Indian Tectonic Zone (CITZ). The CITZ region is characterized by insulated granitic igneous rocks that have a deep basement and a thin crust. This composition encourages geothermal activity. To ascertain the geothermal potential of the CITZ region, a thorough investigation of its geophysical, thermodynamic, and geological characteristics is required. The geothermal gradient, thermal conductivity of the formation rock type, the heat flow, the bottom hole temperature (BHT), the magnetic anomaly, and the gravimetric anomaly were all components of this set of variables. To develop favorability maps that illustrate the potential of geothermal resources, the current study used the Analytic Hierarchy Process (AHP) to establish the relative relevance of these features. By combining GIS with multiple-criteria decision analysis (MCDA), the method was able to create a geothermal map. While CITZ's surface temperature varies from 60 to 95 °C, the reservoir temperature is 105-217 °C. This area has a thermal gradient of 60 to 90 °C/km, which is ideal for estimating the geothermal potential there. Careful consideration went into the selection of geological formations, subsurface temperature gradients, thermal conductivity, and other indicators of geothermal energy potential. In order to aid in decision-making, these characteristics will show the geothermal potential map over the study region. Our approach has satisfied with the reality comparing to geothermal events in those area, like hot springs and aquifers.

To summarize, we have found a hot spring site in an area with significant heat propagation, close to the shear zone of the Central Indian Tectonic Zone (CITZ), as a result of our geothermal potential evaluation. By utilizing the positive aspects found in our research, we can tap into geothermal energy as a sustainable and reliable source of power, which will greatly improve energy security and economic growth in the area.

**Keywords:** Geothermal energy, India, CITZ, thermal conductivity, geological characteristics.

## Formulation and Evaluation of Alpinia Galanga Phospholipid Complex

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### Abstract:

Nanotechnology mediated novel nano sized drug delivery system are gaining boom now a days owing to fascinating physicochemical characteristics and phyto-activity. The development of innovative drug delivery methods for herbal medications has received a lot of interest in recent years. *A. galanga* has been utilized for its various therapeutic activities like anti-diabetic, antiplatelet, antioxidant, antiproliferative and antiemetic. *Alpinia galanga* Linn. rhizomes are utilized in the present study. The current research study is based on a pharmacognostical estimation of *A. galanga* Linn. and the formulation of a phospholipid complex with the plant's rhizomatous section. The standardisation parameters discovered in this work might aid in plant identification and its standardisation in crude form. When *A. galanga* extract was combined with phosphatidylcholine, it inhibited  $\alpha$ -amylase significantly, indicating great anti-diabetic potential in vitro. The phospholipid complexes were evaluated by various parameters like drug content, NMR, DSC and drug permeation study. The findings can help further for botanical identification and development of anti -diabetic formulations of this plant.

**Keywords:** Diabetic, herbal, in-vitro, phospholipid, rhizome

**Exploring Recent Approaches Using Nanostructures for Efficient and Facile Synthesis of Biologically Important Bis(Indolyl)methanes (BIM).**

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**Abstract:**

In recent years, there has been significant advancement in nanostructures utilized as nano catalysts for synthesizing a diverse range of bioactive heterocycles. These nano catalysts exhibit remarkable selectivity and activity, boasting high turnover frequencies (TOF). Particularly, heterocycles featuring indole or Bis (indolyl)methane (BIM) derivatives have garnered widespread attention due to their pharmaceutical effectiveness. Their broad spectrum of bioactivity has spurred demand across industries and biomedical sectors. Consequently, there is a growing emphasis on developing environment friendly and sustainable routes for their synthesis. This review sheds light on the recent strides made in leveraging various nano catalysts to facilitate the synthesis of BIMs, underscoring the importance of green and benign strategic approaches in modern synthetic methodologies.

**Keywords:** Nanocatalysts, Bis(indolyl)methanes, bioactivities.

**Synthesis, Characterization of Novel Pyrazole Derived Schiff Based and Their 3D-Metal Complexes: Anticancer Cell Line, BSA Binding and DFT Study**

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**Abstract:**

Two novel Schiff base ligands have been synthesized by condensation reaction of amine derivative of pyrazole moiety with 2-hydroxy-4-methoxybenzaldehyde. Co(II), Ni(II), Cu(II) and Zn(II) of the synthesized Schiff bases were prepared by using a molar ratio of ligand:metal as 1:1. The structure of the Schiff bases and synthesized metal complexes were established by  $^1\text{H}$  NMR, UV–Vis, IR, Mass spectrometry and molar conductivity. The thermal stability of the complexes was studied by TGA. In DFT studies the geometries of Schiff bases and metal complexes were fully optimized with respect to the energy using the 6-31+ g(d,p) basis set. The spectral data shows that the ligands behave as bidentate tridentate. On the basis of the spectral studies, TGA and DFT data an octahedral geometry has been assigned for Co(II), Ni(II), square planar for Cu(II) and tetrahedral for Zn(II) complexes. The anticancer activity was screened against human breast cancer cell line (MCF-7) and human hepatocellular liver carcinoma cell line (Hep-G2). Result indicates that metal complexes show increase cytotoxicity in proliferation to cell lines as compared to free ligand.

## **Toughened Epoxy Based Nanocomposites Materials for EMI Shielding**

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### **Abstract:**

Modern era devices and appliances require shielding from electromagnetic interference to ensure stable and efficient functioning. This is all the more pertinent in view of the safety and protection of electronic gadgets used in defence security equipment. It has been observed that the most prominent radiations of EMI fall in the range of microwave (GHz) and radio waves (MHz). Those materials which protect equipment from electromagnetic interference are called EMI shields, since they shield the equipment by either reflecting, absorbing, or transmitting the electromagnetic radiation. However, not all materials can be used as EMI shields. The basic material requirement to be used as EMI shields include good ferromagnetic and dielectric properties as well as strong mechanical properties. Currently EMI shields made up of metals or silicones are used in the form of solid enclosures, cables, gaskets, O-rings, films, coatings, fabrics, tapes etc. With time and research new advanced lightweight materials have been developed which have shown potential for use as EMI shields. These include carbonaceous and ferrite nanofillers based polymer nanocomposites. These materials are unique because they provide shielding for a wide range of microwave frequency 2-18 GHz by a judicious choice of conductive, dielectric and ferromagnetic nanofillers. The present review article provides an overview of the research work carried out on toughened epoxy (epoxy modified with other polymers) filled with multifunctional nanoparticles and their characterization for EMI shielding efficiency. Various factors and features have been critically analyzed in this article. The entire focus of the article is aimed at Toughened epoxy as a base matrix which can support EMI shielding in the complete frequency range of 2-18 GHz and overcome inherent disadvantages of non-toughened epoxy.

**Keywords:** Electromagnetic interference, Toughened epoxy, EMI shielding, composites

## **Synthesis and Characterization of Carboxylic Acid Crosslinked Polyvinyl Alcohol Films**

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### **Abstract:**

In this study, polyvinyl alcohol (PVA) crosslinked films were fabricated via the solution casting method, employing various carboxylic acids as crosslinkers. Various tests, including ATR-FTIR, XRD, SEM, AFM, TGA, DSC, tensile strength, contact angle analysis and swelling measurements, were conducted to assess how the different acids' crosslinking abilities affected the physicochemical properties of the resulting films. The outcomes were attributed to the competitive interplay of at least three factors during the crosslinking process: i) crosslinking density, ii) disruption of existing hydrogen bonding in PVA following crosslinking, and iii) incorporation of flexible crosslinkers, with the last factor closely associated with the specific chemical structure of the crosslinker itself.

## **Nanofibers Based Smart Scaffolds for Tissue Regeneration**

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### **Abstract:**

Tissue engineering is an adaptable method that aids in the regeneration or repair of any injured bodily part. The creation of biocompatible scaffolds, which can give cells three-dimensional supports for growth and proliferation, is the most crucial step in tissue engineering. A great deal of work has gone into creating these biocompatible scaffolds for use in tissue engineering. The native extracellular matrix's (ECM) biological activity and structure should be mimicked by the biocompatible scaffold. Up to now, a variety of natural and artificial materials have been tested as scaffolds for tissue engineering. Often referred to as "smart" polymers or intelligent materials, stimuli-responsive polymers are made of polymers with the capacity to react to even minute alterations in their surroundings. These are reversible alterations that lend versatility to these intelligent materials for a range of biomedical applications. We have created composites of conducting poly(3,4-ethylenedioxythiophene), PEDOT, Polyaniline (PANI), and stimuli-responsive materials like poly (N-isopropylacrylamide), PNIPAm, and its copolymer nanofibers as scaffolds for tissue engineering applications because of the intelligence of smart polymers and the conducting nature of electroactive conducting polymers. The electrospinning technology was utilised to generate the nanofibers of composite materials. The conducting nature of the composite material was examined using cyclic voltammetry, and the chemical structure of the composite was verified using FTIR. Scanning electron microscopy was used to measure the average diameter of the composite nanofibers, and the results show that the composite has a slightly larger average diameter than the components alone. The material's biocompatibility was investigated through the seeding of L929 fibroblast cells onto the surface of the nanofibers. Composite nanofibers were seen to exhibit the highest percentage of living cells and cell development, approximately 98%, suggesting that they could be used as a scaffold for tissue engineering applications.

**A Coumarin-Based Optical Probe for the Quantitative Determination of Fe<sup>3+</sup> ions in Water, Petroleum Crude Oil, Catalyst and Natural Samples; An Experimental and Theoretical Investigation**

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**Abstract:**

A simple and sensitive optical probe, designated as "N-((9-benzyl-9H-carbazol-3-yl)methylene)-7-(diethylamino)-2-oxo-2H-chromene-3-carbohydrazide" was designed and synthesized for the accurate quantification of Fe<sup>3+</sup> ions in water, milk, vegetables, petroleum crude oil, and catalyst samples in their prepared aqueous solutions. This probe (referred as Probe-L) acts as a naked-eye chemosensor, undergoing a noticeable color change from light yellow to medium dark brown in an acetonitrile-water medium. It exhibits exceptional selectivity for Fe<sup>3+</sup> ions, even in the presence of interfering elements such as Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Ba<sup>2+</sup>, Cr<sup>3+</sup>, Mn<sup>2+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Cu<sup>2+</sup>, Zn<sup>2+</sup>, Al<sup>3+</sup>, Cd<sup>2+</sup>, As<sup>3+</sup>, Sn<sup>2+</sup>, and Hg<sup>2+</sup>. To determine the sensitivity of Probe-L towards Fe<sup>3+</sup>, we conducted experimental tests and found that it can detect Fe<sup>3+</sup> ions with a concentration as low as 0.001 ppm. Through Job's plot, Thermogravimetric, and high-resolution mass spectrometry (HRMS) studies, we confirmed the 1:1 binding interaction between Probe-L and Fe<sup>3+</sup> ions. Furthermore, computational experiments were carried out to determine the optimal geometry of Probe-L and its metal complex, as well as to calculate the HOMO-LUMO energy gaps. We conducted a comparative analysis of the quantitative results derived from Probe-L in assessing Fe<sup>3+</sup> content across various samples, juxtaposing them with the outcomes obtained through the ICP OES technique. Significantly, our findings demonstrated a favorable concordance with the ICP OES results, indicating the viability of the new techniques for a wide range of practical applications.

**Keywords:** Chemosensor; Quantification of Fe<sup>3+</sup> ions Fluorescence; Water analyses; Turn off sensor.

## **Chemical Composition of Essential Oils of *Plumeria Alba* Pods**

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### **Abstract:**

Essential oils are volatile compounds, extracted from the different parts of the plants like leaves, root, buds, twigs, flowers, barks, rhizomes, bulbs, peels, seeds, resins, wood, etc. by hydrodistillation or steam distillation. At present, essential oils are being used as important constituents in various industries like pharmaceutical, agricultural, cosmetic, food, etc. due to their antibacterial, antifungal, antiviral, antiparasitical, antidiabetic, anticancer, insect repellent, antioxidant, and cosmetic properties. The essential oils isolated from *Plumeria alba* pods are amongst many such oils that have a good number of pharmaceutical applications.

In the present work, the chemical composition of essential oils from the pods of *Plumeria alba*, collected from Udham Singh Nagar District of Uttarakhand state, has been analysed. The analysis aims to find out the chemical components of the essential oil of pods of *Plumeria alba*. The biological activities of the isolated components were also analysed. The essential oils were obtained by hydrodistillation of *Plumeria alba* pods, by the use of Clevenger's apparatus and analysed by GC-MS. About eight constituents were identified from the sample. The main components of *Plumeria alba* pods essential oil were Linalool, Alpha-Copaene, Linalyl acetate, Menthol etc.

**Keywords:** Essential oils, *Plumeria alba*, Hydrodistillation, Pharmaceutical applications, Antioxidant, Antimicrobial

**Validated Direct Chiral Separation of Ketorolac and Amlodipine from Pharmaceutical Formulations and in Human Plasma Using Polysaccharide-based Chiral Stationary Phases**

*Manohar Lal*

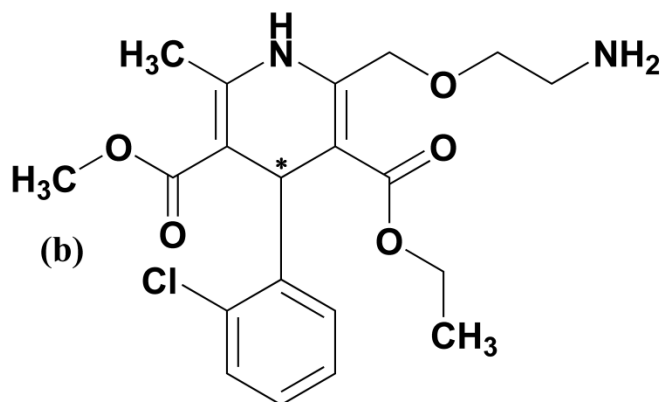
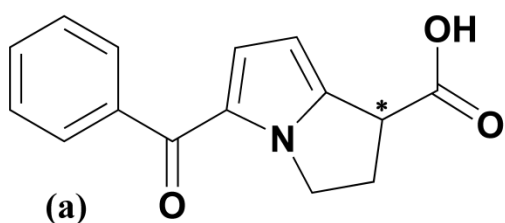
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**Abstract:**

Attempts were made to separate the acidic and basic drug enantiomers, (*RS*)-ketorolac (a) and amlodipine (b), respectively, on two commercialized polysaccharide-based chiral columns, Lux Cellulose-2 and Lux Amylose-2 containing cellulose tris-(3-chloro-4-methylphenyl) carbamate and amylose tris-(5-chloro-2-methylphenyl) carbamate, as the chiral materials, respectively. Enantioseparation were carried out under normal and reversed phase elution mode with suitable mobile phase compositions. The results obtained from two columns were compared among themselves in regards to their ability to provide baseline resolution. The effects of the nature and concentration of alcoholic modifier and pH of mobile phase on the retention and resolution were studied. The detection was made photochemically using photo diode array detector for identification of enantiomers. The effect of alcoholic/ organic modifier on enantioselectivity and resolution of enantiomers was evaluated. The sequence of the eluted enantiomers was ascertained by performing optical rotation studies on polarimeter. The method was validated in terms of accuracy, precision and linearity in the range of 30–70 mg ml<sup>-1</sup> and the *r*<sup>2</sup> was >0.99.

**KEY WORDS:** Ketorolac; Amlodipine; chiral separation; normal and reversed phase HPLC; Validation; Lux Cellulose-2 and Lux Amylose-2



## **Transparent Ceramics: The Material of Next Generation**

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### **Abstract:**

In the first half of the 20<sup>th</sup> century, ceramics were supposed to be an opaque material only. Transparent ceramics seems to be a fantasy before the 1960s. However, the advancement in sintering technologies and continuous research in solid-state materials make the relation between transparency and ceramics. Now, transparent ceramics are a reality and they are fabricated using advanced sintering technologies such as vacuum sintering, hot pressing, hot isostatic pressing, spark plasma sintering, and microwave sintering. Furthermore, sintering aids are additional assets to produce completely dense transparent ceramics with optimum grain size. The use of cold isostatic pressing further ensures the high densification of ceramics. Transparent ceramics based on oxides are leading in the research as well as industry owing to their better mechanical strength and chemical stability, along with easy synthesis process compared to the non-oxide ceramics. Nevertheless, non-oxide-based ceramics are also emerging and some quantum amount of research is also taking place in this arena. Transparent ceramics exhibit a unique fusion of high optical transmittance and toughness. Initially, these ceramics were developed for high-power solid-state laser applications and replaced single crystals. However, with time and progress in fabrication technologies, these ceramics also find their applications in various other fields, such as lighting, scintillating, protective windows, transparent armour, optical lenses, biomedical, etc.

**Keywords:** Transparent ceramics; Solid-state lasers; Optical transparency; Sintering; Mechanical strength

**A Quinazolinone Based Optical Probe for the Simultaneous Determination of Fe<sup>3+</sup> and Cu<sup>2+</sup> Content in Aqueous Samples; An Experimental and Theoretical Investigations**

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**Abstract:**

The chemosensor “3-((1-(7-(diethylamino)-2-oxo-2H-chromen-3-yl)ethylidene)amino)-2-(4-(4-methylpiperazin-1-yl)phenyl)-2,3-dihydroquinazolin-4(1H)-one”, (referred as probe) was synthesized with the primary objective of accurately quantifying Fe<sup>3+</sup> and Cu<sup>2+</sup> ions in various prepared samples originated from petroleum crude oil, catalysts, fruit, milk, vegetables, and water from diverse sources. This probe serves as a naked-eye probe, displaying distinct color changes in an aqueous medium, transitioning from light yellow to dark brown for Fe<sup>3+</sup> and pale green for Cu<sup>2+</sup> ions. Remarkably, it displays exceptional dual selectivity for Fe<sup>3+</sup> and Cu<sup>2+</sup> ions, even in the presence of potentially interfering elements such as Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Ba<sup>2+</sup>, Cr<sup>3+</sup>, Mn<sup>2+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Zn<sup>2+</sup>, Cd<sup>2+</sup>, As<sup>3+</sup>, Sn<sup>2+</sup>, and Hg<sup>2+</sup>. Experimental assessments demonstrated the probe's high sensitivity, detecting concentrations as low as 0.001 ppm for both Fe<sup>3+</sup> and Cu<sup>2+</sup> ions. The 1:1 binding interaction between the probe and the metal ions was established through Job's plot, thermogravimetric analysis, and elemental analysis.

Computational experiments were performed to determine the optimal geometry of the probe and its iron & copper complexes, revealing an octahedral geometry for both complexes. A comparative quantification analysis of Fe<sup>3+</sup> and Cu<sup>2+</sup> content across diverse aqueous samples was executed using both ICP OES and new method. Notably, the results exhibited a favorable concordance with ICP OES outcomes, affirming the practical viability of these novel techniques for a wide range of samples.

## **Modeling & Simulation of a Canister for Hydrogen Storage**

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### **Abstract:**

Hydrogen storage is the bottle neck in hydrogen economy. Compressed and liquid storage have limitation of safety & cost considerations. Solid state hydrogen storage shows a promising solution for this problem. Some metallic alloys including HEAs absorb hydrogen in the form of metallic hydrides. The process is endothermic and heat released during H<sub>2</sub> absorption must be carried away otherwise it will affect the absorption capacity and kinetics of the reaction. Also for the desorption we have to supply the heat. For this we have modelled a canister for 1 Kg H<sub>2</sub> storage capacity assuming 2.5 % gravimetric capacity. Different configurations like parallel tube, spring type spiral configuration and spiral triangular configuration have modeled and heat transfer analyses was done with in ANSYS and Comsol multiphysics. Out of the above three, spiral triangular cross section geometry was found best for quick and complete heat transfer.

**Keywords:** H<sub>2</sub> Hydrogen in gaseous form, HEAs- High Entropy Alloys

## Comparative Study of Preclinical Data on Toxicological Effects of Monosodium Glutamate in Animals

Aashish Kumar Sagar

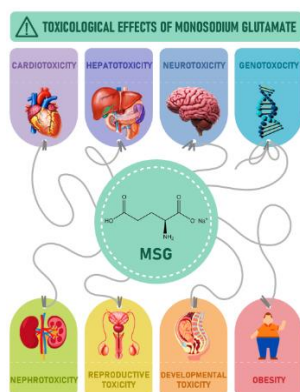
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### Abstract:

The use of taste enhancers or seasonings has been increased in recent time. Monosodium glutamate (MSG) or Sodium glutamate, derived from L-glutamic acid is one of the most widely used food additive worldwide and is known as E621 in the food industry. It is made by fermenting various carbohydrate sources like sugar beet, sugar cane, and molasses. MSG intensifies the flavor with an Umami taste- the fifth basic taste alongside sweet, sour, salty, and bitter which produces a meaty and savory flavor in food. This is carried to study the accessible literature on preclinical data on toxicological effects of MSG in animals including obesity, cardiotoxic, genotoxic, neurotoxic, hepatotoxic effects, with effects on GI-tract and endocrine system. Preclinical data from various studies has been taken both for animal and human trials and hence a comparative view has been plotted between them. As administration of MSG at same dosage shows different behavioral, biochemical, physiological changes. Finite study has been done on humans to check possible toxicological effects of MSG. Further studies are aimed to research and focus the hazardous effects of MSG more on humans as inadequate preclinical data of toxic effects is present on humans. Moreover, we reviewed the medicinal plants and their active constituents which have been used to treat MSG-induced effects. It is observed that intake of turmeric, ginger and garlic can reduce the health risks along with food rich in vitamin-C and vitamin- E. Hence detailed research is needed to examine MSG toxicity and its related health aspects.

**Keywords:** Monosodium glutamate; Food additives; Food chemistry; Toxicological effects; Hepatotoxicity.



**Instrumental Techniques Used in the Utilisation of *Pueraria Montana* Weed as Lignocellulosic Fiber**

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**Abstract:**

Lignocellulosic fibers hold high demand due to their biodegradability, lightweight, low cost, sustainability, and most importantly easy availability in nature which make them advantageous over synthetic fiber. Invasive species are spreading all over the world due to their rapid mode of replication and are detrimental to forests and agriculture. *Pueraria montana* (kudzu) is a wild plant species that is declared a terrestrial invasive alien species and contains potential fiber in its vines. Fiber extracted from the vines of *Pueraria montana* might be a futuristic source for the textile industry. Present study aims to utilize *Pueraria montana* weed for the isolation of lignocellulosic fiber and its characterization using different instruments. Surface analysis was done using scanning electron microscopy. Physical properties were analysed using Stelometer (for bundle strength), TGA (for thermal analysis). Structural analysis was studied using FTIR, Solid State NMR and XRD. The chemical composition demonstrated the removal of lignin. Solid-state NMR illustrated the breakdown of hemicellulose linkages at 25.89 ppm. FTIR revealed the disappearance of C=O groups of hemicellulose at 1742 cm<sup>-1</sup>. TGA demonstrated thermal stability of chemically treated fiber up to 361.2 °C and activation energy of 30.50 KJ/mol. XRD evidenced that chemically extracted fiber has a crystallinity index of 40.61% and a crystal size of 2 nm. SEM demonstrated the fibrillar structure of the chemically extracted fiber.

## Synthesis and Characterization of Crosslinked Guar Galactomannan Using Malic Acid

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### Abstract:

Guar galactomannan (GG) is a natural polysaccharide extracted from the endosperm of the plant *Cyamopsis tetragonolobus*. It is widely used in many industries due to its excellent rheological properties and non-toxic nature. The present study focuses on the modification of GG without using any catalyst via solvent casting method to enhance its mechanical, thermal and water barrier properties.

The effect of various reaction parameters such as crosslinker concentration (0.0074 mol to 0.0223 mol), curing temperature (115°C - 145°C), and curing time (4, 7, 10 min) on swelling% and solubility% of modified product (GMA) were investigated. Further, the structure of the crosslinked product was characterized using spectroscopic techniques FTIR and NMR (1-D, 2-D). The major peak observed in FTIR at 1727 cm<sup>-1</sup> indicated ester linkage which was confirmed by liquid state <sup>1</sup>HNMR (peaks at 2.92 ppm, 4.64 ppm), <sup>13</sup>C NMR (peaks at 173.11 ppm). Crosslinking of GG with malic acid was also confirmed by XRD spectra. The TGA results showed that the crosslinked product exhibited higher thermal stability in comparison to native GG. The drug loading and release was investigated in different pH condition mimicking the colon environment. The results demonstrated that GMA can be used as a carrier for colon specific drug delivery due to its controlled drug release property, stability over wide pH range and also found biocompatible against bacteria.

**Keywords:** Crosslinking, polysaccharides, galactomannan, dicarboxylic acid, malic acid

## **Crosslinking of Guar Galactomannan with Green and Economical Crosslinker Citric Acid**

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### **Abstract:**

Guar gum, a plentiful and renewable galactomannan, is unsuitable for end use application due to issues like vulnerability to microbial contamination, rapid swelling, lack of pores, and brittleness. To overcome these limitations, researchers have modified galactomannan by crosslinking it with citric acid, an eco-friendly, water-soluble tricarboxylic acid with natural plasticizing properties, using environmentally conscious methods. The present study converges on the modification of the guar gum via crosslinking with the citric acid. In our laboratory, 0.00555 mol of guar gum was chemically crosslinked with citric acid, whose concentration varied from 0.00052 mol to 0.0104 mol at varying temperature ranging from 80°C to 140°C. Thermal and mechanical stabilities of the obtained reaction products were analyzed and characterized by spectroscopic methods (FT-IR, NMR), XRD, TGA, DSC, SEM, swelling degree, and solubility percentage. The degree of crosslinking was determined in terms of degree of di-esterification using complexometric titration method, the crosslinked product was obtained in the form of film, which showed a decreasing pattern in swelling degree from 13.43g/g (max.) to 2.712g/g (min.) and solubility percentage from 66.4% (max.) to 23.7% (min.). The crosslinking occurred due to the formation of the ester bond, whose presence was evidenced by a characterized peak in IR spectroscopy at 1741.02, further supported by the peak at 174.26 ppm in solid-state <sup>13</sup>C-NMR spectra. The crosslinked product further subjected for methylene blue dye removal from aqueous solution and displayed good MB adsorption at room temperature. The modified product has great capabilities to be utilized in the field of drug delivery, wound healing, tissue engineering, etc.

**Keywords:** Guar gum, Crosslinking, citric acid, NMR, FTIR, Degree of di-esterification (DDE), MB dye removal.

**Procurement Challenges & Solutions for Government Research Organisations**

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**Abstract:**

The procurement of goods and services by government research organisations is governed by their internal procurement & contracts manuals. These manuals are created based on various govt. documents i.e. GFR-2017, Manual for procurement of Works 2019, Manual for Procurement of Consultancy and Other Services 2017, Manual for procurement of Goods 2017, etc. The manuals of government organizations & PSUs are capable and effective to address the procurement requirements of industrial type goods and services but when it comes to procurement of special kind of niche services, scarcely available goods, protected goods and services, customized research equipments, specially designed pilot plants, etc used at various research organization, these Government & PSU manuals felt short.

In the talk, we have tried to address the challenges faced by the government research organizations & PSUs in procuring the goods and services required for their new and ongoing research. The speaker will also address the upcoming developments in public procurement especially GeM (government e-marketplace) including the role of AI in public procurement. The speaker will also provide the detail methodologies of public procurement being followed at various PSUs and would also try to provide the solution to remove/ address various bottlenecks faced in the procurement by government research organizations & PSUs.

## CO<sub>2</sub> Photoreduction integrated with oxidative coupling of amines over WO<sub>3</sub>/Cu(BTC) nanocomposite

Anil Malik<sup>1,2</sup> and Suman L Jain<sup>1</sup>

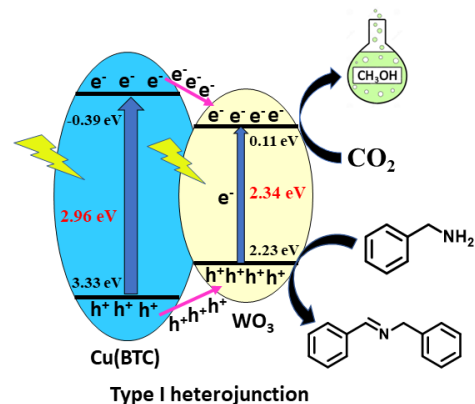
<sup>1</sup>CSIR- Indian Institute of Petroleum, Dehradun 248005, Uttarakhand

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### Abstract:

This work have an efficient integrated CO<sub>2</sub> photoreduction to methanol accompanied with the simultaneous oxidation of benzyl amines to corresponding imines using quadrangular WO<sub>3</sub> nanoplates grafted with Cu(BTC) MOF as a photocatalyst under visible light, enabling to provide efficient use of the photogenerated electrons and holes. Under the optimized reaction conditions, the maximum yield of methanol and N-(4-methoxybenzyl)-1-(4-methoxyphenyl)methanimine was found to be 642  $\mu\text{mol-g}^{-1}$  and 98%, respectively. The developed integrated dual functional photocatalytic system comprising CO<sub>2</sub> reduction coupled with the oxidative organic synthesis opens a new window for value chain up gradation at both ends using sustainable solar energy.



Keywords: CO<sub>2</sub> photoreduction, imine synthesis, dual catalysis, Metal organic framework.

**GC-MS/GC-FID Based Compositional Analysis of Essential Oil from *Thymus Serpyllum* L**

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**Abstract:**

*Thymus serpyllum* L. also referred to as wild thyme or creeping thyme, holds a distinct position in ethnopharmacology because of its diverse range of applications. Though it's native to the Mediterranean area, it has expanded to the Western Himalayas in India [1], where it is locally known as 'Ban ajwain' and 'lepti ninayi'. Enthused by its usage in various traditional remedies due to a series of pharmacological properties [2], it was envisaged to analyze it for volatile constituents. Aerial parts of the herb (collected from Chakrata, Dehradun, India) were subjected to hydro-distillation in a Clevenger apparatus leading to a yellow-colored essential oil in 0.56±0.09% yield on a moisture-free basis. Gas Chromatography-Mass Spectrometric and Gas Chromatography-Flame Ionisation Detection analysis of essential oil led to the identification of 38 compounds, out of which thymol (35.25±0.85%), p-cymene (27.57±0.65%), thymol acetate (8.03±0.32%),  $\gamma$ -terpinene (6.92±0.21%) and  $\beta$ -bisabolene (5.0±0.1%) were found to be the major constituents, inferring that the herb is of thymol chemotype. Further, the mass fragmentation pattern of major terpenes and terpenoids analyzed in essential oils has been proposed for the first time based on scientific facts and reasoning. The current research could potentially uncover various applications for this herb across pharmaceuticals, flavorings, fragrances, and cosmetics industries. The study may promote the cultivation of these herbs along the sides of walls and field bunds, effectively harnessing a significant bioresource for livelihood generation. The authors declare that they have no conflicts of interest.

**Key Words:** *Thymus serpyllum*, essential oil, GC-MS, GC-FID, thymol.

*Acknowledgments: The authors are grateful to the Director, ICFRE-Forest Research Institute, Dehradun for providing the necessary lab facilities and instruments to carry out the present study.*

## Exploring the Potential of Renewable Biomass for Engineering Applications

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### Abstract:

Renewable biomass, derived from organic materials such as plants, agricultural residues, and organic waste, presents a sustainable alternative to fossil fuels and various other value added materials. Its abundance, low cost, and carbon-neutral properties make it an attractive resource for engineering applications. This paper examines the utilization of biomass for energy generation, including biofuels and biolubricant production, and preparation of aerogels for Gunshot wound and waste water remediation including dyes adsorption and oil-water separation. Additionally, it delves into the use of biomass-derived materials in engineering processes, such as bio-based polymers, biocomposites, and bio-based chemicals. Challenges such as biomass supply chain logistics, technological advancements, and economic viability are discussed, along with opportunities for innovation and growth in the field. Overall, this abstract highlights the significant potential of renewable biomass as a versatile and sustainable resource for various engineering applications, contributing to the transition towards a greener and more sustainable future.

**Keywords:** Biofuels, Biolubricants, Aerogels, Hydrophobicity, Dye adsorbents, Oil-water separation

**Characterization of MOFs-Derived MWCNTs for H<sub>2</sub>-storage using advanced analytical techniques**

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**Abstract:**

Zeolitic imidazolate frameworks (ZIFs) serve as potential hydrogen storage candidates as they offer the synergistic effect of MOFs which opens a passage of opportunities to be explored as for hydrogen adsorption by tailoring ZIFs according to our needs. This is possible when we can relate the synthesis and structure to the hydrogen adsorption characteristics of the material. In this context, mixed metal based ZIFs with multiwalled carbon nanotubes (MWCNTs) have been explored to develop Solid adsorbents for efficient Hydrogen storage due to their unique structural properties and tunable characteristics.

Herein, Co-Zn@ZIFs and Co-Zn@ZIFs@MWCNTs frameworks were synthesized using a room temperature solvothermal method. Various characterization techniques including TEM, SEM, EDS Elemental mapping, P-XRD, TGA, and BET-SA confirmed the formation and stability of these frameworks for efficient hydrogen storage at room temperature. The cubical, hexagonal and rhombic dodecahedron morphologies with larger surface area exhibited superior hydrogen adsorption properties. There was a clear correlation between morphology and hydrogen adsorption characteristics, determined by surface area and pore volume attributes of the material. The morphology and size of the ZIFs can be tailored based on synthesis conditions to optimize their adsorption capabilities. Hydrogen adsorption capacity was evaluated at room temperature, yielding values ranging from 0.51 to 0.55wt% for Co-Zn@ZIFs and Co-Zn@ZIFs@MWCNTs, respectively. This research opens new possibilities for MOF-based hydrogen storage tanks in future fuel cell technology applications.

**Second Generation Ethanol Production Via Improved SSCF Using Rice Straw at Low**

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**Abstract:**

Bio-ethanol is a renewable alternative to fossil fuels which facilitate energy security and reduce greenhouse-gas emissions. Cost effective production of second-generation ethanol (2G) using surplus agriculture residues is major challenge for commercialization of 2G ethanol technology. For economical viable production of second generation ethanol depends upon the low CAPEX and OPEX. In this work, a process was developed for ethanol production using improved SSCF at low enzyme dosage (5 FPU/gTS). Overall 2G ethanol production (hydrolysis and fermentation) was completed within 48 h having ethanol concentration 50 g/L. A minimal nutrient source, such as NH<sub>4</sub>OH and MgSO<sub>4</sub> were used in this fermentation practice. In this process, pretreated biomass was used without detoxification, solid-liquid separation, sterilization. NH<sub>4</sub>OH used for adjustment of pH 5 of dilute acid pretreated biomass, which also provides ammonium sulfate as nitrogen source. Xylose was fermented upfront which improved the hydrolysis even at low enzyme dosage and lower enzymatic hydrolysis time (20 h), followed by glucose fermentation. These results suggested that, SSCF process has great potential for commercial scale ethanol production at high titer of ethanol with easy operation at low CAPEX and OPEX.

**Keywords:** *Saccharomyces cerevisiae*; Lignocellulosic ethanol; Simultaneous saccharification and co-fermentation

**Micropores in Hollow Organic Cage Nanocapsule as a Size Exclusion Gate: Cage Entrapped Pd(II)-Catalyst for Efficient Cross-Coupling Reaction**

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**Abstract:**

Hollow porous organic capsules (HPOCs) with an entrapped active catalyst have nanosized cavities, providing the benefits of a nanoreactor, as well as separation of the catalysts from the reaction medium via pores acting as a size-exclusion gate. Such purpose-built HPOCs with desired molecular weight cutoffs offer the advantages of semipermeable membrane separation and a sustainable chemical process that excludes energy-extensive separation. Here, we report a newly synthesized HPOC with an entrapped  $\text{Pd}(\text{PPh}_3)_2\text{Cl}_2$  as the catalyst for demonstrating a Suzuki–Miyaura coupling reaction as a proof of concept.

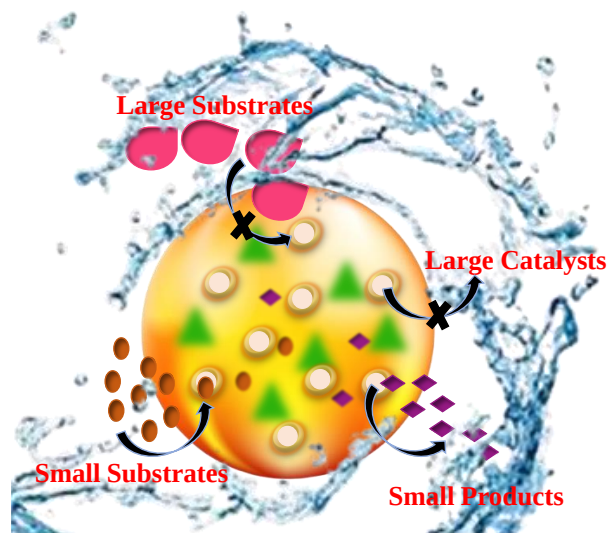


**Figure 1.** Schematic representation of the reaction scheme for the monomers at the droplet interface

## **Hydrogen Mobility in India**

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### **Introduction:**

Decarbonizing the transportation sector is an environmental priority globally and hydrogen, the cleanest and most plentiful of fuels, is central to achieving this goal. It is a zero-emission fuel that emits only water vapor when burned, making it a greener alternative to fossil fuels. Natural gas, biomass, and renewable energy sources such as solar and wind power can all be used to generate hydrogen.

The transportation sector contributes significantly to greenhouse gas emissions, accounting for approximately 23% of worldwide emissions in 2019. Transition of transportation sector from fossil fuel towards clean energy sources is required to mitigate climate change. Hydrogen mobility appears to be a viable option for achieving sustainable transportation. Hydrogen fuel cell electric vehicles (FCEV) have significant advantages over battery electric vehicles (BEV), especially for long-distance travel. FCEVs have larger ranges and faster refilling times than BEVs, making them better suited to heavy-duty vehicles for long-distance passenger transit.

### **Hydrogen Mobility Worldwide**

The hydrogen market is valued at \$242.7 billion in 2023 and is projected to reach \$410.6 billion by 2030, with a compound annual growth rate (CAGR) of 7.8%. The global hydrogen fuel cell vehicle market size was estimated at almost US \$1 billion in 2021 and is expected to hit around US \$43.2 billion by 2031 registering a CAGR of 45.5%. Germany, France, Japan, Australia, Norway, and the U.S. are strong proponents of hydrogen mobility. South Korea's Hyundai, Japan's Toyota & Honda and Germany's Mercedes, have already gone to market with their hydrogen fuel cell vehicles.

### **India's perspective on Hydrogen Mobility**

Hydrogen fuel cell technology is still in its early stages in India, and hydrogen vehicles are still not widely available. India is making sincere efforts in the development of its hydrogen mobility sector. The government has been encouraging public-private partnerships and international collaborations to accelerate progress. India, heavily reliant on crude oil imports, is exploring fuel cell technologies to meet its growing energy demand sustainably. Various research institutions and organizations like IOCL, BHEL and CSIR are actively engaged in PEMFC development. Despite significant progress at individual levels, there's a pressing need for collaborative efforts among industry, academia, and government to address technology gaps and accelerate commercialization.

India has been gradually progressing in the realm of hydrogen mobility, albeit at a slower pace compared to some other countries. A snapshot of the current status:

- **Government Initiatives:** The Indian government has shown interest in promoting hydrogen as a clean fuel. In November 2021, India's Minister for Road Transport and Highways announced plans to introduce hydrogen-powered vehicles, including buses and trucks, as part of the country's efforts to reduce carbon emissions.
- **Hydrogen Policy:** India released its National Green Hydrogen Mission in 2021, aiming to establish India as a global green hydrogen hub by 2040. The government of India has set goals to produce 5 million metric tonnes of green hydrogen per year by 2030.
- **Public and Private Projects:** Several public and private entities in India have initiated projects related to hydrogen mobility. For instance, Indian Oil Corporation (IOC) has been exploring hydrogen fuel cell technology for transportation, including buses and cars. Additionally, Tata Motors, Mahindra & Mahindra, Ashok Leyland have conducted research and development activities related to hydrogen-powered vehicles.
- **Hydrogen Fueling Infrastructure:** Establishing hydrogen refueling infrastructure is crucial for the widespread adoption of hydrogen-powered vehicles. While India is still in the nascent stages of developing hydrogen refueling stations, there have been discussions and pilot projects to explore the feasibility of such infrastructure. Indian Oil has established 3 hydrogen refueling stations at different regions in India.
- **Collaborations and Partnerships:** Indian organizations have been partnering with international counterparts to leverage expertise and accelerate the adoption of hydrogen mobility. These collaborations focus on technology transfer, joint research, and knowledge sharing to address challenges in hydrogen production, storage, and utilization.
- **Indian Oil is undertaking a demonstration project of Fuel Cell buses which aims to develop indigenous fuel cell stack technology and its integration with fuel cell buses.** Under this demo project India's first green hydrogen fuel cell buses were introduced by IndianOil in New Delhi on September 25, 2023. In this project, demonstration of 15 fuel cell buses (each covering 20000 kms) will be undertaken for establishing the efficacy, efficiency, and other performance parameters of the fuel cell technology for heavy duty applications which will help to understand the challenges of adopting H2 in mobility and thus help to pave the way for developing right legal framework and policies to foster the growth of this fast-emerging sector.
- **Tata Motors has signed an agreement with Cummins, Inc., a global provider of power solutions and hydrogen technologies, to collaborate on designing and developing low- and zero-emission propulsion technology solutions for commercial vehicles in India.**

## **Design And Application of Air Purifier Tower for Indoor and Outdoor Areas**

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### **Abstract:**

Currently, pollution is a pressing global issue, with a focus on air pollution in this discussion. Pollution involves the release of harmful chemicals, particulates, and biological substances into the environment, negatively impacting human, animal, and plant life, leading to various diseases like lung cancer and heart conditions. Air pollution in indoor and outdoor areas can be controlled using an Air Purifier Tower (APT). This APT incorporates an electric fan, a negative ionizer, an activated charcoal bed, and three types of filters. The filters include a Pre-Filter, a HEPA filter, a HiSiv filter, and an activated carbon filter or activated carbon bed. This APT is capable of removing PM<sub>2.5</sub>, PM<sub>10</sub>, total volatile organic compounds (TVOCs), airborne particles, microbes, smoke, toxic air, cigarette smoke, and fumes from polluted air. Over 90% of PM<sub>2.5</sub>, PM<sub>10</sub>, TVOC, and other pollutants are removed within 80 seconds of operation in a controlled volume of 70 m<sup>3</sup> containing 1000 mg/m<sup>3</sup> of PM<sub>2.5</sub> and PM<sub>10</sub>, as well as 7.5 mg/m<sup>3</sup> of TVOC. This present model has less initial investment and operation costs of ₹ 9500 & ₹ 6/hr respectively.

Keywords: Particulate matter (PM); TVOC; negative ionizer; Activated charcoal

## **Crosslinking of Galactomannan with Green Plasticizer Malonic Acid using Green Chemistry for Biomedical Applications**

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### **Abstract:**

Naturally occurring polysaccharides have pronounced significance due to their abundant and sustainable availability in environment, eco-friendliness, biodegradability and low cost. The present study depicts crosslinking of guar galactomannan. Guar gum is a specialty galactomannan that serves as an abundant, renewable and sustainable feedstock. Selection of reactants, solvent, catalyst, energy for environment friendly reaction is done using green chemistry approach. In our study, guar galactomannan has been crosslinked with a green crosslinker 'malonic acid' to develop a biodegradable, eco-friendly, natural biopolymer film which overcomes the major drawbacks in the native properties of guar gum such as brittleness, non-porosity, high swelling rate and microbial susceptibility. Interestingly, malonic acid also acts as an auto catalyst during esterification and subsequent crosslinking. The reaction conditions were optimized by varying concentrations of malonic acid (0.5%, 1.5%, 2% w/v), temperature (55 °C, 100 °C, 120 °C, 140 °C) and time (5,10,15 min) to introduce 1,3-propane dioates in the galactomannan chains resulting in flexible crosslinked films of galactomannans. Further, the effect of low and high curing temperature on crosslinking has been investigated by analysis of the degree of di-esterification for the first time. The mechanism of crosslinking with a dicarboxylic acid has also been proposed. Detailed analysis of films has been achieved by NMR (1D & 2D), FTIR, XRD, TGA and DSC. Further, curcumin has been loaded in these crosslinked films and kinetic studies via the Korsmeyer-Peppas model demonstrate that curcumin has non-fickian diffusion controlled release mechanism (DCR). The antibacterial, antifungal and antioxidant studies depict that prepared formulation has potential utility in sustained drug delivery and other biomedical applications. Altogether, these studies provide a foundation to develop a sustained drug release system using crosslinked films for wound healing, anticancer therapy and many more. Thus, sincere efforts have been made to convert sustainably available biomass to useful products having vital biomedical applications.

**Keywords:** green chemistry, biodegradable, natural plasticizer, guar galactomannan, malonic acid, curcumin, biomedical application

**The synthesis of 4-(4-fluorophenyl)-1,2,3-selenadiazole and its experimental investigation of corrosion-inhibition properties on mild steel in 1M HCl**

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**Abstract:**

This study used 4-(4-fluorophenyl)-1,2,3-selenadiazole (4FSDZ) as a corrosion inhibitor on mild steel (MS) in a 1M HCl environment. The compound was synthesized, and characterized by NMR and MASS spectrometer. Electrochemical impedance spectroscopy (EIS) shows that when the concentration of (4FSDZ) in an acidic solution increases, the charge transfer resistance increases and double-layer capacitance decreases, indicating that the metal is being protected. The phase angle plot indicates that the increases in phase angle value with increasing inhibitor concentration show that the metal/solution interface exhibits capacitive behavior on the MS surface because of the corrosion inhibitor's adsorption action.

A potentiodynamic polarization (PDP) study reveals that the inhibitor under investigation possesses a mixed-type inhibitory mechanism and exhibits good inhibition efficacy. In a 1M HCl solution, the corrosion current density reduces as the inhibitor concentration rises, suggesting that mild steel corrosion can be controlled by raising the concentration of 4FSDZ in the acidic solution. As the concentration of 4FSDZ in the acidic solution increased, the rate of both cathodic and anodic reactions decreased. The adsorption of inhibitor molecules on the MS surface was verified by scanning electron microscopy of the inhibited and uninhibited MS samples. SEM results indicate that 4-(4-fluorophenyl)-1,2,3-selenadiazole exhibits significant adsorbing properties. According to experimental findings, 4FSDZ has good corrosion-inhibiting properties.

**Keywords:** Mild steel, Corrosion, EIS, PDP

**Petunia Surfinia extract as Green inhibitors for mild steel corrosion in acidic environment**

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**Abstract:**

Driven by the increasingly overwhelming environmental issues caused by the widespread application of traditional toxic corrosion inhibitors, eco-friendly inhibitors have attracted strong attention over the past decades. Green inhibitors are produced from cheap and renewable sources and simultaneously offer high inhibition efficiency and low or even zero environmental impact. Herewith, we study the Petunia Surfinia as corrosion inhibitor on mild steel in 1.0 M Hydrochloric acid. Advanced techniques such as weight loss, electrochemical impedance, and potentiodynamic polarization techniques provide ample evidence that Petunia Surfinia is very effective in retarding mild steel corrosion. We critically examine the mechanisms of corrosion inhibition and relate to the available experimental data. The abundance of p-electrons of multiple bonds and heteroatoms in the form of polar functional groups leads to the active adsorption of the inhibitor's molecules on the mild steel surface. Weight loss and electrochemical spectroscopy results shows that this plant extract is a good corrosion inhibitor, shows 91% and 90% respectively at a optimum concentration of 1000ppm.

**Key words:** Corrosion inhibitor, HCl, Mild steel

## **Assessment of Microplastic Contamination in Surface and Groundwater of the Himalayan Region in Uttarakhand**

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### **Abstract:**

Microplastics (MPs) and heavy metals (HMs) contamination pose significant hazards to ecosystems and human health. In response to this pressing concern, a comprehensive study has been undertaken to assess MPs and HMs contamination in various surface and groundwater locations across Uttarakhand. To assess the presence of MPs and HMs in the study area, a total of 33 samples were collected, including 11 surface water (SW) samples and 12 groundwater (GW) samples. The characterization and quantification of MPs were carried out using optical microscopy and Fourier Transform Infrared Spectroscopy (FTIR), whereas HMs were analyzed through Inductive Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) with a limit of detection of 0.01 ppb. In SW, the number of pieces of MPs was found to be 81, and in GW, it was 152. The SW samples collected near the industrial area contained the highest number of MPs, with dominant shapes being film, fiber, and microbeads, whereas in GW, the dominant shapes were film, fiber, and fragments. This shows a significant correlation of aquifer recharge with the surrounding SW. The HMs identified in SW and GW were aluminum (Al), copper (Cu), iron (Fe), and zinc (Zn). Among the SW samples, 27% samples exceeded the acceptable limit for Fe (0.3 ppm). Similarly, 27% of the GW samples exceeded the acceptable limit for Fe (0.3 ppb), reflecting their unsuitability for drinking water. The FTIR analysis indicated that the observed peaks in the spectrum closely align with the characteristic peaks of polyethylene terephthalate (PET) in both SW and GW, a prevalent type of plastic extensively used in applications such as beverage bottles, food packaging, and textiles. This comprehensive study signifies a crucial advancement in understanding and addressing the contamination of MPs and HMs in the study area, which will help in the development of mitigation strategies.

**Keywords:** Microplastic, Heavy metals, Surface water, Groundwater, FTIR, Quantification.



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