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TEMPUS

Newsletter

Department of Chemical Engineering

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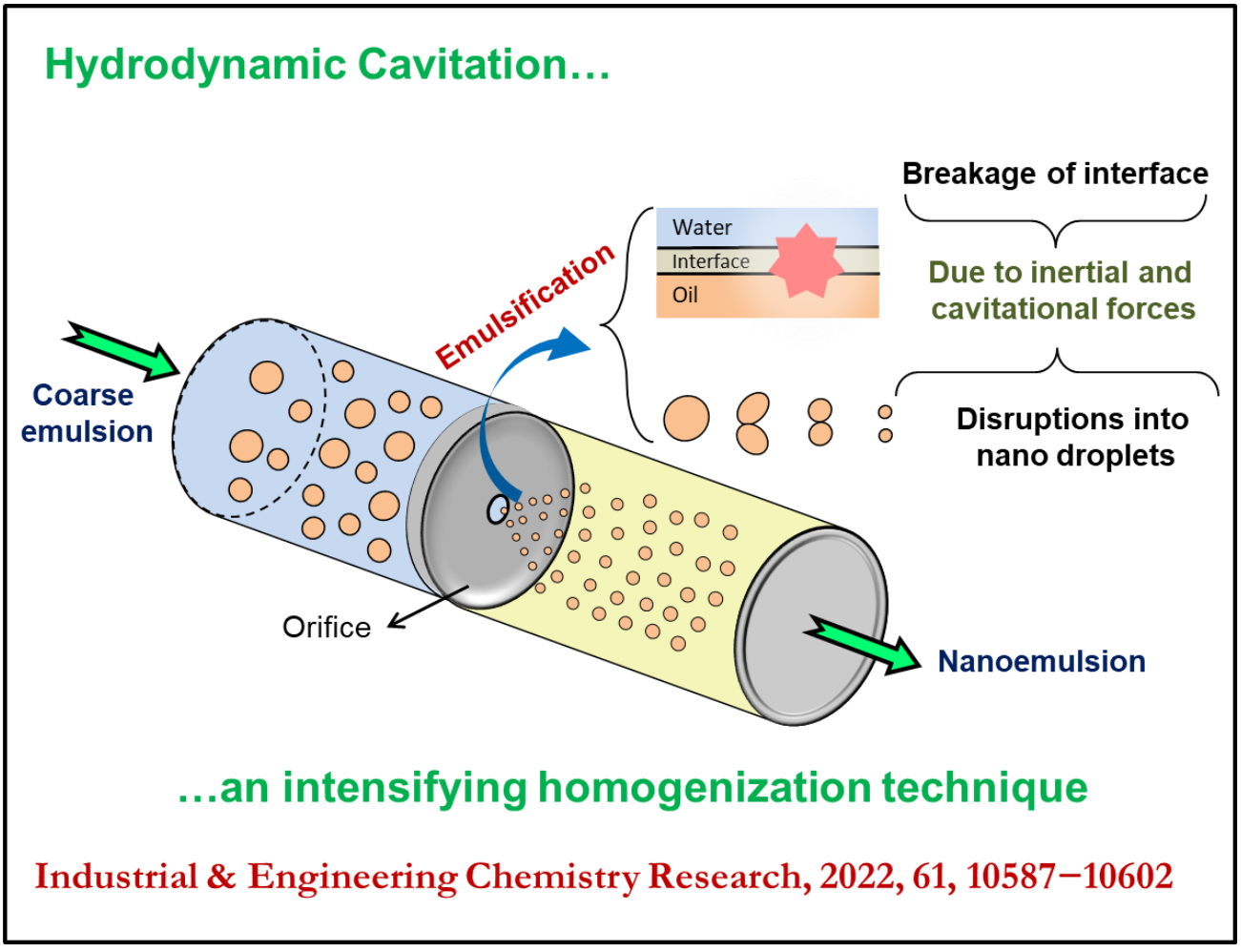

Contents

From the HOD's Desk

Dear Readers,

Greetings,

I am glad to present the December 2024 issue of our department's newsletter. In this issue, we showcase the latest updates and accomplishments and highlight the talent and dedication within our department. You will find insightful articles, research updates, faculty and student achievements, and exciting event highlights on these pages. I encourage you to read, engage, and share your thoughts.

The past six months have been a period of academic and research excellence for our department. Faculty and students have actively contributed to research, professional development, and industry collaborations, reinforcing our commitment to innovation and quality education.

One of the key highlights was the successful organization of the ***VGST-sponsored Faculty Development Program (FDP) on "Advances and Recent Trends in Environmental and Energy Applications of Nanomaterials" from December 4–7, 2024.*** *This FDP brought together experts from academia and industry to discuss cutting-edge developments in nanotechnology and its applications in energy and environmental sustainability. We also have organised* ***Schrodinger Material Science Workshop-2 on Computational Catalysis from 14th - 16th November 2024****.*

Our faculty continues to make remarkable strides in research. We are proud to share that ***three of our faculty members have been recognized among the top 2% of scientists worldwide****, a testament to their impactful contributions in their respective research domains. Additionally,* ***three of our faculty members received prestigious research awards from MAHE for their outstanding work****, further elevating the department's academic stature.*

Students have also excelled in various domains, securing competitive internships, placements, and research opportunities in leading organizations and universities. The department actively organized guest lectures, workshops, and industrial visits to enhance students' learning experiences and bridge the gap between academics and industry. Looking ahead, we are committed to strengthening research initiatives, fostering industry collaborations, and ensuring academic excellence.

I extend my heartfelt gratitude to the faculty, students, and alumni for their unwavering dedication and contributions. Let us continue striving for innovation and excellence in chemical engineering.

Best regards,

Dr. M. Srinivas Kini
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Manipal Institute of Technology, MAHE, Manipal-576104.
Email: srinivas.kini@manipal.edu

From The Students

CARBON CAPTURE AND STORAGE

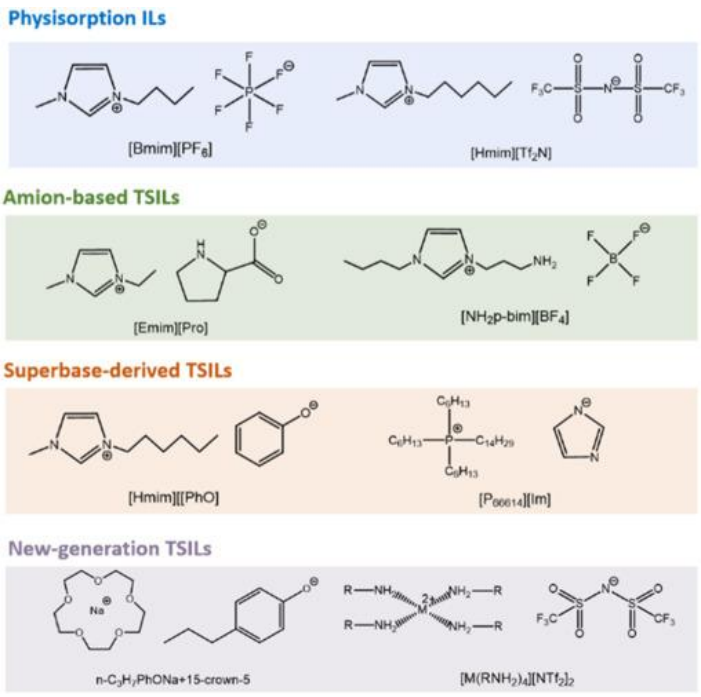
Aadya Verma (B.Tech. Batch of 2027)

Carbon capture and storage (CCS) is the process of capturing carbon dioxide formed during power generation and industrial processes and storing it so that it is not emitted into the atmosphere. CCS can be seen as a bridge technology, allowing for the continued use of fossil fuels in electricity generation and industry until low-carbon alternatives can be implemented. CCS may also be necessary to achieve the negative CO_2 emissions required for the 1.5°C and 2°C climate goals.

The first step in a CCS operation is capturing CO_2 from an industrial process. Combustion processes that lead to highly concentrated–or even pure–CO_2 streams are more energy efficient for CO_2 capture. One approach is to use pure oxygen instead of ambient air in the combustion process, a process termed oxyfuel. Oxyfuel combustion leads to an almost pure stream of CO_2, although other constituents such as water vapor still need to be removed. Gas separation is a common industrial process and is often achieved through sorption of CO_2 to a fluid with high affinity to CO_2. A third approach is to convert fossil fuel into a carbon-less fuel such as hydrogen before the combustion. This process is termed precombustion capture. Lastly, post-combustion CO_2 capture primarily entails retrofitting existing facilities, enabling a rapid and cost-effective mitigation strategy to curtail the escalation of carbon emissions in the short term.

Further explored in the post-combustion capture is the use of pure ionic materials and ion hybrid materials with their increased adsorption capacity, adjustable adsorption rate, and enhanced operational stability. Ionic functional materials possess unique characteristics such as adjustable acid-base polarity, anion-cation synergy, hydrogen bond-electrostatic-ion cluster coupling, and strong structural design, enabling them to exhibit excellent performance in CO_2 capture and separation applications.

At present, ionic liquids used for carbon capture are broadly categorized into physical absorption and chemical adsorption based on their capture mechanisms.



Physical-absorbed ILs rely on anionic and cationic structures to absorb and dissolve CO_2 through non-chemical bonds such as hydrogen bonds and van der Waals forces. Molecular dynamics simulations and calculations further determine the solubility of CO_2 in different ILs and the ILs-CO_2 interaction at the interface.

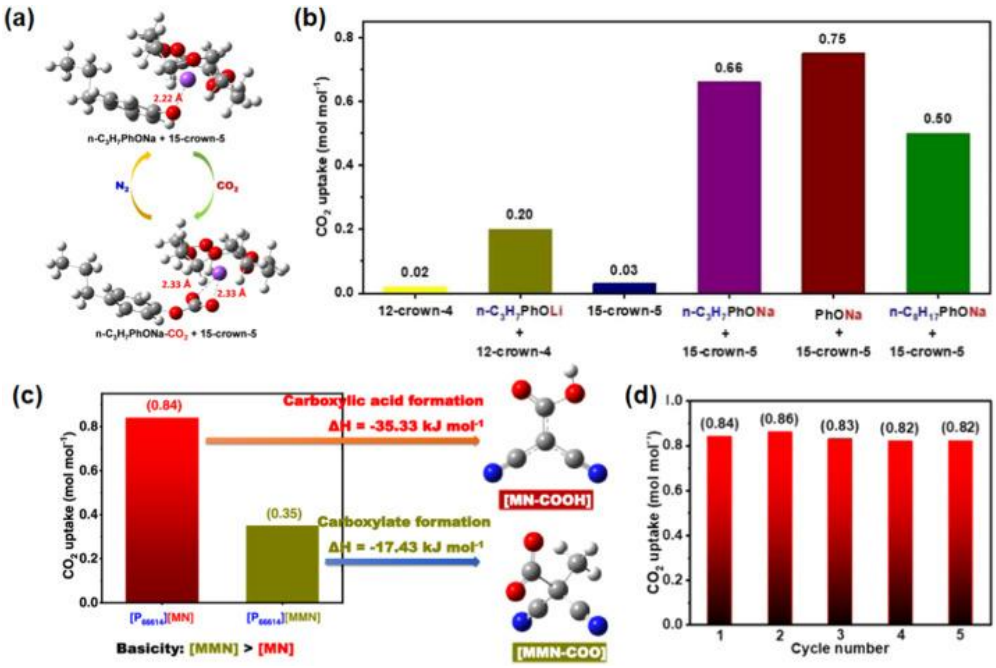
Amino-functionalized “task-specific” ionic liquids (under chemisorption ILs) are effective carbon capture materials combining ionic

materials and amine-based adsorbents. These materials have significantly enhanced carbon capture capabilities. However, the amino groups in IL and acidic CO_2 are still fixed at a molar ratio of 2:1 due to the reaction to form carbamates. To solve this problem, amino groups are grafted onto anions so that the absorption capacity could be increased to an amino: CO_2 ratio of 1:1.

Superbase-derived “task-specific” ionic liquid- In order to balance the adsorption capacity and mass transfer efficiency of ionic liquids, researchers have also conducted a series of studies on the exploration of basic functional ionic liquids such as pyrroles, phenols, and hydroxyl groups. Another strategy to regulate the absorption enthalpy of CO_2 is to rationalize the basicity of ionic liquid anions. A comprehensive study indicated a linear correlation between the pKa values of anions and the absorption enthalpy of CO_2 within ionic liquids, which means an elevation in the pKa value of anions directly augments the absorption enthalpy.

New-generation “task-specific” ionic liquids- Recently, using synthetic chemistry and computational simulation techniques to regulate the microenvironment of the adsorption site has become a hot spot. For example, imidazole-based ILs are the most common ionic liquids in the field of carbon capture and separation. There are two mechanistic paths to absorb CO_2. One is the direct reaction of basic anions with acidic CO_2 to form carbamate; The second is that the acidic C_2-H in the imidazolium cation is removed by the basic anion to form carbene, which is combined with CO_2 to form imidazole carboxylate, but the latter has low absorption and is not easy to desorb.

A low-carbon future means tackling emissions from the fossil-fuelled power fleet using every means available. Ultimately, there is no foreseeable situation where we sustain life without carbon capture tech- It is the need of the hour.



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Department Events

Faculty Development Program on “Advances and Recent Trends in Environmental & Energy Applications of Nanomaterials” (Dec 04-07, 2025)

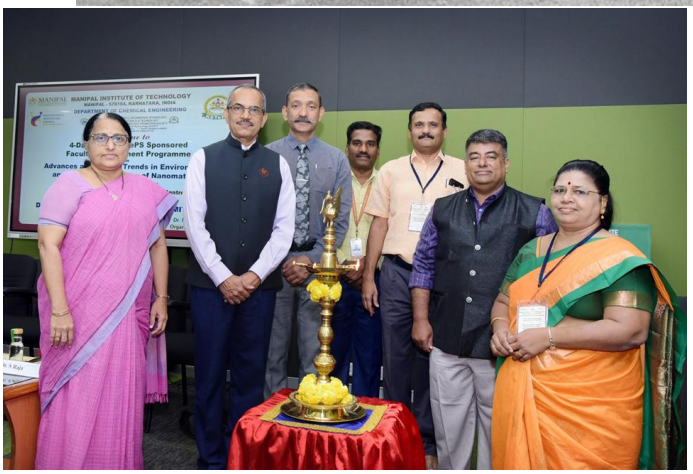
Department of Chemical Engineering organized a four-day Faculty Development Program (FDP) titled "Advances and Recent Trends in Environmental and Energy Applications of Nanomaterials" from December 4 to 7, 2024, at MIT, Manipal. The program was sponsored by VGST/KSTePS and held at the KEF Auditorium, MIT.

The FDP brought together 55 participants from various parts of India, creating a platform for knowledge exchange and networking. The event featured nine insightful lectures by eminent experts from prestigious institutions:

- **Dr. Vidya Shetty K**, National Institute of Technology Karnataka (NITK), Surathkal, on bioengineered nanomaterials for environmental sustainability.
- **Dr. Vivek Rangarajan,** BITS Pilani – K. K. Birla Goa Campus, on biosurfactants-based nanoemulsions for sustainable applications.
- **Dr. Bharath Govindan,** SRM Institute of Science and Technology, Chennai, on photoelectrocatalytic conversion of CO2 into fuels.
- **Dr. Murugadoss Govindhasamy**, Sathyabama Institute of Science and Technology, Chennai, on perovskite solar cells.
- **Dr. Durai Govindarajan,** Chulalongkorn University, Bangkok, on circular economy and advanced electrode alternatives for supercapacitors.
- **Dr. Vaishakh Nair**, NITK, Surathkal, on waste management and nanotechnology for sustainable agriculture.
- **Dr. Jagannathan T Kalathi,** NITK, Surathkal, on polymer nanocomposites for energy storage applications.
- **Dr. Ramesh Pathy Manian**, VIT, Vellore, on advancements in biofuel production through nanotechnology.
- **Dr. MohanKrishna Gunda,** KLE Technological University, on bioelectrochemical systems for sustainable development.

Hands-on sessions included lab visits to CIF and CAIF facilities at MIT and an industrial visit to Adani Power Limited, Padubidri. Participants appreciated the rich learning experience, interactive sessions, and exposure to cutting-edge advancements, making the event a significant success for the department and its stakeholders.

Convenor: Dr. S. Raja & Co-convenor: Dr. V. Ramesh, of the event.



Visit of 1984 Batch Alumni to the Department of Chemical Engineering

On 16th December 2024, the Department of Chemical Engineering at MIT, Manipal, welcomed its esteemed alumni from the Batch of 1984 for a memorable visit. The reunion served as an opportunity for the alumni to reconnect with their alma mater, relive cherished memories, and witness the department's growth and advancements. During their visit, the alumni toured the laboratories and facilities, interacted with faculty and students, and shared insights from their professional journeys.

Schrodinger Material Science Workshop -2 | Computational Catalysis
14th - 16th November 2024

From the 14th to the 16th of November, 2024, the Manipal Institute of Technology (MIT) hosted the Schrödinger Material Science Workshop-2 on Computational Catalysis organised by the Department of Chemical Engineering brought together a vibrant assembly of students, faculty, and researchers from various institutes under the Manipal Academy of Higher Education (MAHE), Manipal.

The workshop commenced with an inspiring inaugural address by the esteemed MIT Director, Cdr. (Dr.) Anil Rana. His eloquent discourse underscored the paramount importance of interdisciplinary research, setting a motivating tone for the workshop. Dr. Rana's address illuminated the pivotal role of computational tools in expediting research and development, urging participants to delve into the vast potential of computational molecular modeling. Prof. Srinivas Kini, Head of the Department of Chemical Engineering, led the organizing committee with aplomb, extending a warm welcome to chief guest and all attendees.

The workshop featured a series of lectures on molecular simulations, complemented by hands-on training sessions. These sessions delved into the multifaceted applications of computational molecular modeling of computational catalysis, materials science, chemical engineering, and chemistry. Eminent scientists from Schrödinger, Bengaluru, including Dr. Saientan Bag and Dr. Sriram Krishnamurthy, graced the event with their expertise, providing in-depth demonstrations of the Schrödinger Suite's formidable capabilities.

Participants had the opportunity to engage in practical exercises, honing their skills in building material system environments, performing surface reactions, conducting catalysis studies, and executing density functional theory (DFT) calculations. This hands-on approach ensured that attendees garnered valuable insights into the latest advancements in computational catalysis.

The workshop's success was further accentuated by the enthusiastic participation of over 39 attendees from diverse scientific and engineering disciplines. Their active engagement underscored the burgeoning interest in computational catalysis and its myriad applications.

In conclusion, the Schrödinger Material Science Workshop served as an invaluable platform for participants to explore cutting-edge advances in computational catalysis. It equipped them with the requisite skills to pursue pioneering scientific explorations and contribute to research excellence.

Schrodinger Material Science Workshop , Chemical Engineering

Convenor: Dr. Srikanth Divi & Co-Convenor: Dr. Anoop Kishore Vatti for Schrodinger Material Science Workshop-2 | Computational Catalysis.

Alumni Interaction on “Research and Job Opportunities in the US”

On 30th August 2024, the IIChE Manipal Chapter hosted an engaging alumni interaction at Hampi Hall, AB2, focusing on research and job prospects in the United States. The event featured two accomplished alumni: Suvaleena Paul, Assistant Vice President at Bank of America and a 2019 graduate of MIT Manipal, and Dr. Oishi Sanyal, Assistant Professor at West Virginia University and a 2012 graduate of MIT,Manipal. Both speakers shared their academic and professional journeys, providing valuable insights for Chemical Engineering students aspiring to explore opportunities in the US.

The session witnessed enthusiastic participation, with students asking thought-provoking questions about navigating higher studies and careers abroad. The speakers addressed these queries in detail, offering practical advice on networking, skill enhancement, and adapting to new professional environments. Their guidance on leveraging educational opportunities and building impactful careers resonated deeply with the audience, making the event a significant success.

IIChE Board Transfer Program - 28th November, 2025

The IIChE Board Transfer program was held on 28th November at M.V Seminar Hall, marking a significant moment for the student chapter at MIT, Manipal. The event was addressed by Dr. M. Srinivas Kini, Head of the Department of Chemical Engineering, who emphasized the importance of student leadership in advancing professional development and fostering collaboration. Dr. Gautham Jeppu, the Faculty Advisor, expressed gratitude to the outgoing board for their dedicated service and highlighted their achievements. Ms. Rhea, the outgoing Secretary, and Mr. Kedar Joglekar, the outgoing Treasurer, shared their experiences and reflected on their journey with IIChE, encouraging the new board members to continue the chapter's legacy of excellence. The program celebrated the contributions of the outgoing team while setting a positive tone for the incoming leadership.

Orientation Program for B.Tech 1st Year Chemical Engineering Students - 2024

The Department of Chemical Engineering at MIT, Manipal, conducted its orientation program for first-year B.Tech students on 20th July 2024. The event introduced students to the department's academic environment, expectations, and facilities. It began with a Department Orientation session led by Dr. M. Srinivas Kini, Professor and Head of the Department, followed by an enlightening talk on engineering and chemical engineering by Dr. D.V.R. Murthy, an adjunct professor with vast experience in academia.

In the second half, Dr. B.H.V. Pai shared valuable insights on life as an engineer in Manipal, focusing on best practices and behavioral expectations. The program concluded with a guided tour of departmental laboratories and facilities, facilitated by faculty members including Dr. S.V.S.R. Krishna Bandaru, Dr. V. Ramesh, and Dr. P. Vairavel. Approximately 60 students attended, with 18 faculty members actively participating to ensure a comprehensive introduction to the department.

Establishment of Externally Funded Research Labs in the Department

1. Sensing and Remediation Research Centre (SRRC)

(***Funded by ICMR SERB, VGST & MAHE)***

The Sensing and Remediation Research Centre (SRRC) focuses on advancing sensor technologies and remediation strategies to address environmental challenges. SRRC is funded by various funding agencies like ICMR, SERB, AICTE, VGST and MAHE. The different backgrounds of investigators: Dr. Nethaji S, Dr. Kapil Sadani, Dr. Pooja Nag and Dr. Harshini Dasari lead to the focus on emerging horizons of multidisciplinary research. Our research encompasses the development of innovative sensing assays capable of detecting contaminants at trace levels by utilizing cutting-edge technologies such as micro and nanoscale sensors. The optical and electrochemical sensors are designed to monitor environmental parameters in real-time, providing critical data for effective remediation efforts. In addition to sensor development, our lab investigates various remediation techniques, including adsorption and advanced oxidation processes. By integrating sensor data with remediation processes, we aim to enhance the efficiency and effectiveness of environmental clean-up operations. Our interdisciplinary approach combines expertise from chemistry, engineering, and environmental science, fostering collaboration to tackle complex environmental issues. Through our research, we strive to contribute to sustainable practices that protect ecosystems and public health.

The laboratory is organized into several compartments, such as a wet lab, electrochemical workstation, screen printing room, microbiology room and optical room, each designed to facilitate specific research activities.

The wet lab is equipped with a photocatalytic reactor, cooling centrifuge, dip coater, syringe pumps, and multiple furnaces. This lab is designed for conducting experiments related to chemical reactions and material synthesis. Adjacent to it, the optics room specializes in optical sensing techniques, employing methodologies like localized surface plasmon resonance (LSPR), evanescent waves, and various forms of spectroscopy including Raman and near-infrared (NIR). It is equipped with advanced spectrophotometers that facilitate comprehensive analyses of environmental contaminants, enhancing the detection capabilities for a wide range of analytes.

The electrochemical workstation supports studies on electrochemical sensing techniques such as cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS), utilizing precision instruments like Autolab and Palmsens Potentiostats to detect pollutants like antibiotics and food toxins. The screen-printing room is tailored for fabricating substrates for optical and electrochemical sensors, featuring a custom-built screen-printing system along with equipment for mixing materials and curing inks. Lastly, the microbiology room is dedicated to the preparation and analysis of biological samples, ensuring a sterile environment with equipment such as a laminar airflow system, incubator shaker, and autoclave for sterilization. This facility collectively enhances research capabilities across multiple scientific domains.

2. Cavitation Process Engineering Lab (CPE lab)

(***Funded by Vision Group On Science and Technology (VGST), State Govt. of Karnataka and Manipal Academy of Higher Education (MAHE), Manipal***)

A “Cavitation Process Engineering Lab” sponsored by Vision Group on Science & Technology, State Govt. of Karnataka (VGST) and Manipal Academy of Higher Education (MAHE), Manipal on a project “Design and development of low energy hydrodynamic cavitation-based homogenizer for the synthesis of food and pharmaceutical grade oil-in-water nanoemulsions: experimental & molecular simulations insights” has been established on 04th November 2024. The main goal of this lab is on the development of energy efficient homogenizers for nanoemulsion production and also on the development of food and pharmaceutical grade nanoemulsion based products.

The major facilities developed/established under the funded project in the lab include a hydrodynamic cavitation reactor, Freeze dryer, UV-spectrophotometer, and Ultrasonic processor. The project and the CPE lab are headed by PI Dr. Jitendra Carpenter, Assistant Professor, and Co-PI Dr. Anoop Kishore V, Associate Professor, Department of Chemical Engineering, MIT, MAHE, Manipal.

Research activities under progress in CPE Lab:

- Synthesis of food and pharmaceutical-grade nanoemulsions with long-term shelf life and development of processes.
- Design and development of low energy hydrodynamic cavitation-based homogenizer for the production of nanoemulsions
- Development of polymer-carrier systems for the application of targeted drug delivery:
- Synthesis and applications of drug-loaded nanoemulsions based formulations for cancer therapy
- Development of extraction techniques for the extraction of bioactive molecules

Faculty Achievements

Most Admired Teacher Award 2024

Dr. Anoop Kishore Vatti, Associate Professor, Department of Chemical Engineering, Manipal Institute of Technology (MIT), Manipal, has been honoured with the Best Teacher Award 2024 for his exceptional dedication and innovative teaching methods. Known for his engaging lessons and unwavering commitment to student success, Anoop has transformed the learning experience. His ability to inspire and motivate students and his innovative use of technology in the classroom sets him apart as a true educational leader. This award recognizes his outstanding contributions to education and his relentless pursuit of excellence, making a lasting impact on both students and colleagues.

Best Researcher Award

- Dr. S. Raja, Professor, has received the **Best Researcher Award** in the Chemical Stream and the **Overall Best Researcher Award at MIT** for the year 2024.
- Dr. S. Raja, Professor, has been honored with the **Award for Significant Contribution to the Achievement of SDG,** the Award for Research Excellence, and recognized as the Overall Best Researcher at MIT for the year 2024.

Dr. S. Raja, Professor, and **Dr. V.Ramesh, Professor** of the Department has has been recognized as a **top-cited scholar**, ranking among the **top 2% worldwide** in the field of **Biotechnology/Environmental Sciences** for the year 2024.

Student Achievements

Heartiest Congratulations to the talented students of UG Chemical Engineering

Ms Radhika Krishna B and Ms Dona Aristo from final year and Ms Santusti Gour from third year, for winning 'first prize' in the poster presentation at the "Paryavaran 2024" event, held at MS Ramaiah Institute, Bengaluru recently. Their project titled "Bioinspired Metal-Organic Framework based Nanocomposites for Carbon Dioxide Reduction to Solar Fuels" not only showcased innovation but also won them a 10,000 cash award. Special appreciation goes to these young innovators for their incredible work at the VGST Centre of Excellence, funded by VGST, Government of Karnataka, which is a testament to their hard work and dedication.

Heartiest Congratulations to the talented students Ms Santusti Gour and Mr Rishith Khanna from third year, for winning 'first prize' in the ChemQuiz and Case Study presentation at the "Exergy 2025" event, held at IIT Kanpur, Kanpur recently. Their idea not only showcased innovation but also won them a total of 20,000 cash award. Wishing them many more successes and accolades in the future.

Journal Publications

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Book Chapters:

1. Synthesis and characterization of TiO_2-$Cu_3(BTC)_2$ metal organic framework based advanced materials for photocatalytic CO_2 reduction", Recent Advances in Material, Manufacturing, and Machine Learning, Proceedings of 2nd International Conference (RAMMML-23), 1st edition, Chapter 19, CRC press, ISBN9781003450252, 2024.

Invited Talks/Sessiona Chair

1. Dr. Anoop Kishore delivered an Invited Talk on "Ionic Liquids and Deep Eutectic Solvents as Asphaltene Aggregation Inhibitors: A Molecular Dynamics Simulations Study," DAE Symposium on Advances in Atomistic and Continuum Modeling (DAE-SAACM2024)" organized by Chemical Engineering Group, Bhabha Atomic Research Centre in association with the Society for Atomistic and Continuum Modeling (SACM) at DAE Convention Centre, Anushaktinagar, Mumbai during October 23-26, 2024.
2. Dr. Shanmuga Priya chaired the session at "International Conference on Sustainable Energy and Green Technology, SEGT 2024,15th – 18th Dec 2024, Bangkok, Thailand.

Fun Zone

Fun Zone: Chemical Engineering Riddles!

1. **The Speed Booster**

I break bonds but don't mend hearts.

I speed things up but never run.

Without me, reactions would take forever.

Answer: Catalyst

2. **The Hot Traveler**

I move from hot to cold without a ticket.

I follow the rules of conduction, convection, and radiation.

I help engineers design efficient systems.

Answer: Heat

3. **The Tower of Separation**

I stand tall in refineries.

I separate based on boiling points.

Crude oil is my best friend.

Answer: Distillation

4. **The Invisible Thief**

I sneak through walls but leave no trace.

I move from high to low concentration.

I follow Fick's Law wherever I go.

Answer: Diffusion

5. **The Carbon Catcher**

I trap something that's warming the planet.

I help industries reduce their footprint.

My goal is to keep the air clean and green.

Answer: Carbon Capture

6. **The Bubble Maker**

I help remove the bad stuff from water.

I rise up in columns, making tiny spheres.

Without me, wastewater would be a mess!

Answer: Air

7. **The Pressure Player**

I keep things flowing without a break.

I push gases and liquids with all my might.

Without me, pipelines wouldn't work right!

Answer:

8. **The Mixing Magician**

I blend things together, smooth and right.

In reactors, I make sure no reactant hides.

Without me, reactions would be quite a sight!

Answer: Stirrer

9. **The Foam Fighter**

I keep reactors from making a bubbly mess.

I stop too many bubbles from rising, I confess.

I'm needed in breweries and chemical plants alike!

Answer: Antifoaming

10. **The Timekeeper**

I decide how long molecules stay.

Too fast or too slow, and things go astray.

Engineers tweak me to get the best yield today!

Answer: Residence

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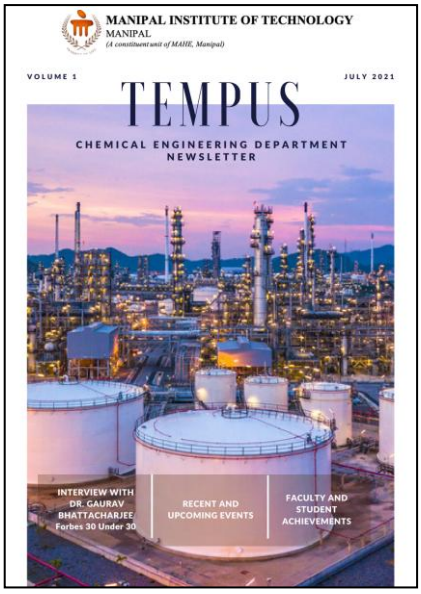
Alumni Reminiscences

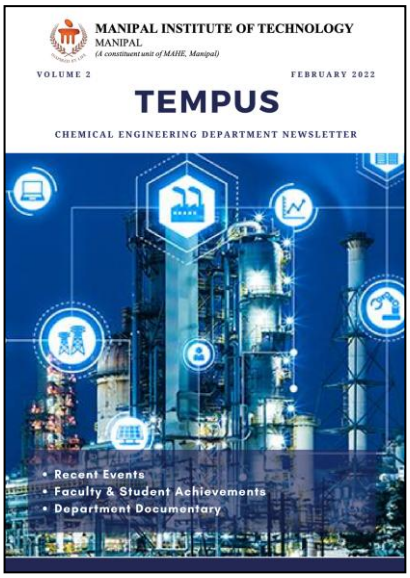
Here comes a fantastic opportunity for our MIT alumni. Pen down your best memories, thoughts, lessons, and experiences you have had on our campus in your college days and get them published in our next Tempus issue! Hoping to read the mind-boggling stories and epic pictures

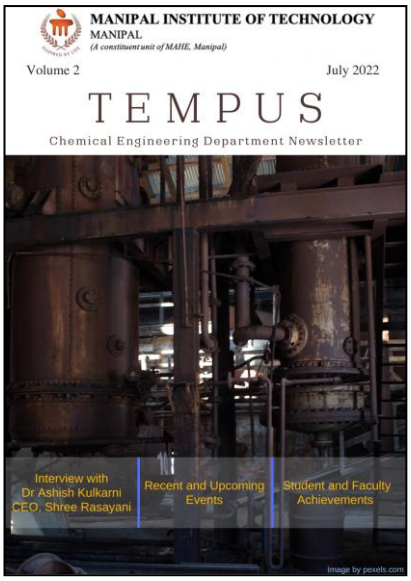
https://forms.office.com/r/rS8rY7SWf3

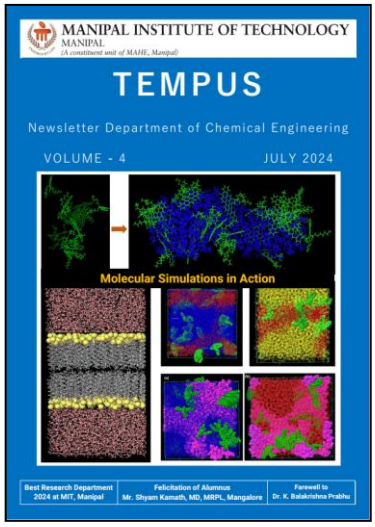
TEMPUS Archives

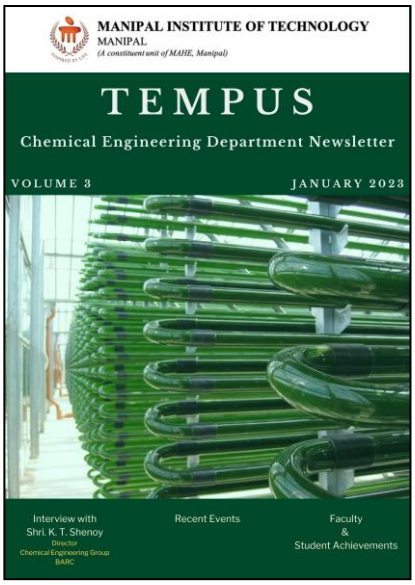
Take a deep-dive into our previous edition here!

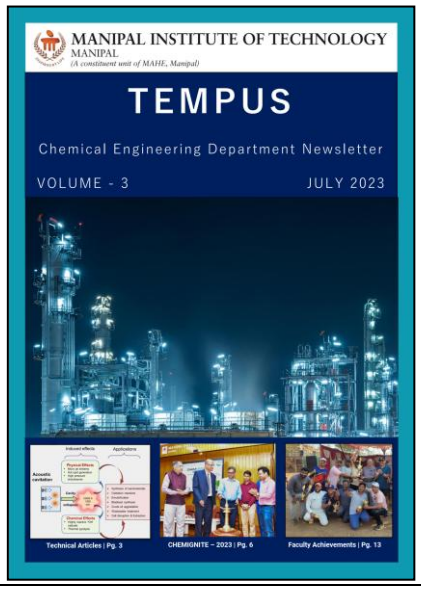


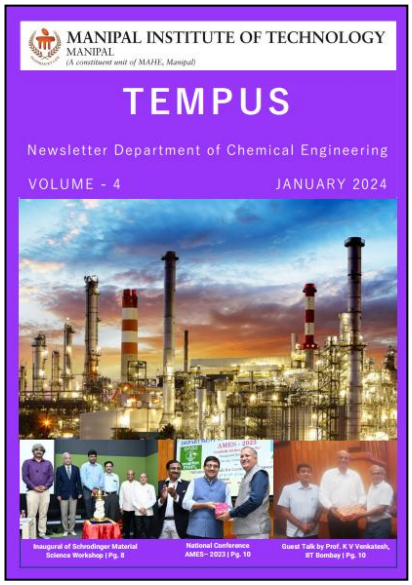












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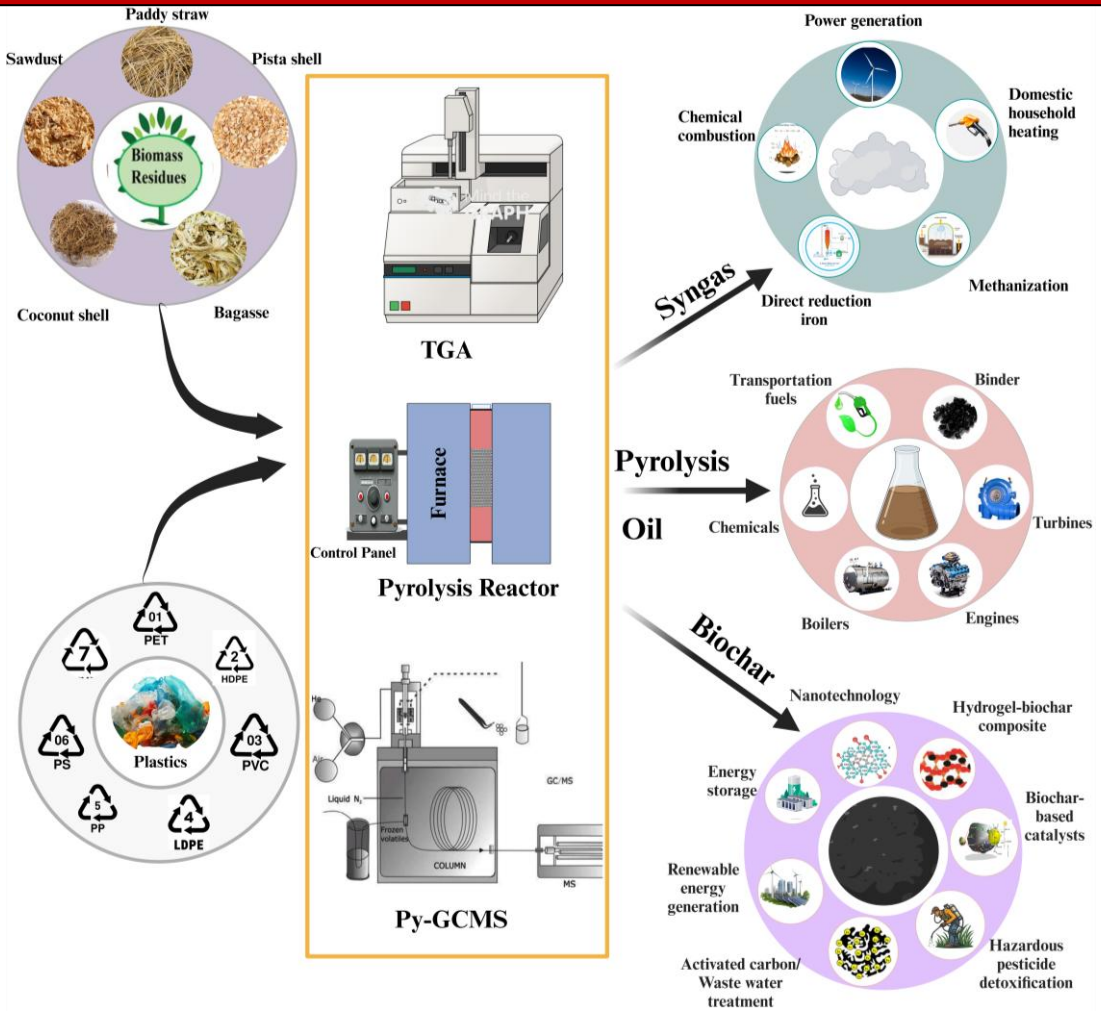

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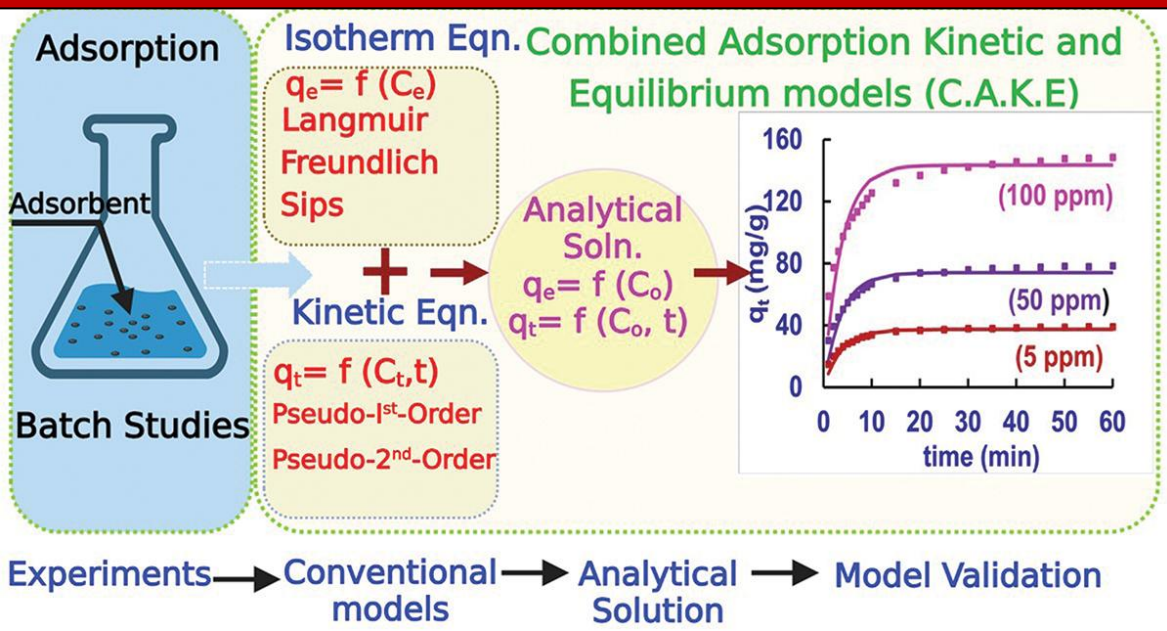

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