April 2023

CSI Communication

Monthly Newsletter of Catalysis Society of India

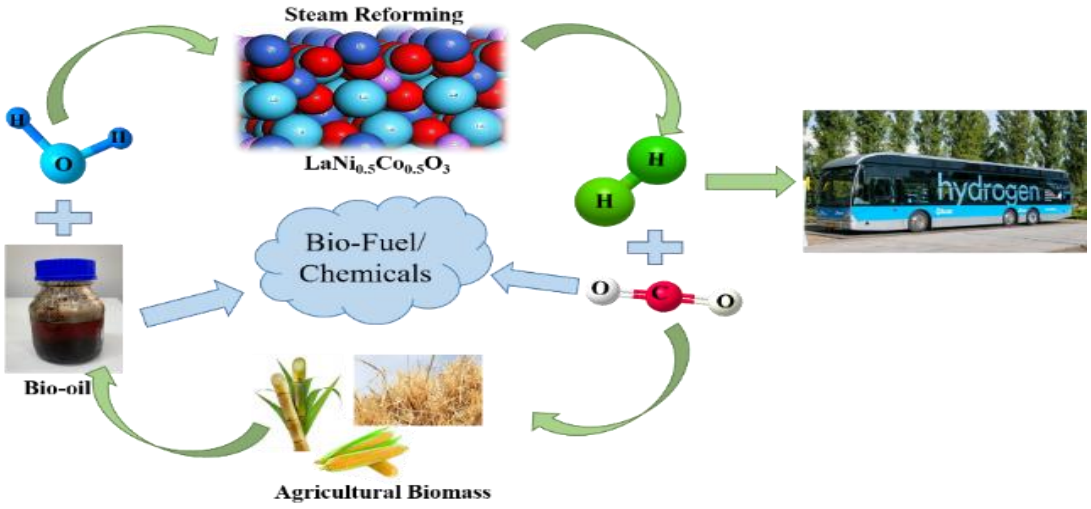
Circulated to all CSI Members

Important Announcement:

CSI newsletter shall be pleased to publish half a page write-up under the title, Centre of Excellence in Catalysis Research in India from any Indian Academics, Research laboratories or Industrial organizations. You may send your brief write-up on your research activities to us which will be published in coming issues of CSI.
You can also share your recent happy moments like publications, granted patents, technology commercialization, fellowship, awards, etc. to highlight in the CSI communication.

Catalysis Sustainable Energy Research Laboratory (CSERL), @ Prof. Tarak Mondal IIT Ropar

The Catalysis and Sustainable Energy Research Laboratory (CSERL) at the Indian Institute of Technology Ropar, under the leadership of Dr. Tarak Mondal, Assistant Professor, Department of Chemical Engineering is devoted to advancing sustainable energy production through the utilization of novel catalytic materials derived from eco-friendly resources. The primary research objective of the laboratory is to convert waste materials, such as agricultural and plastic wastes, into high-value products, including green hydrogen and fuel-grade chemicals, through biomass conversion routes. Additionally, CSERL is focused on the development of efficient bio-fertilizers using various green approaches to enhance existing agricultural system. The laboratory is committed to reduce the carbon footprint while promoting sustainable energy production and catalysis.



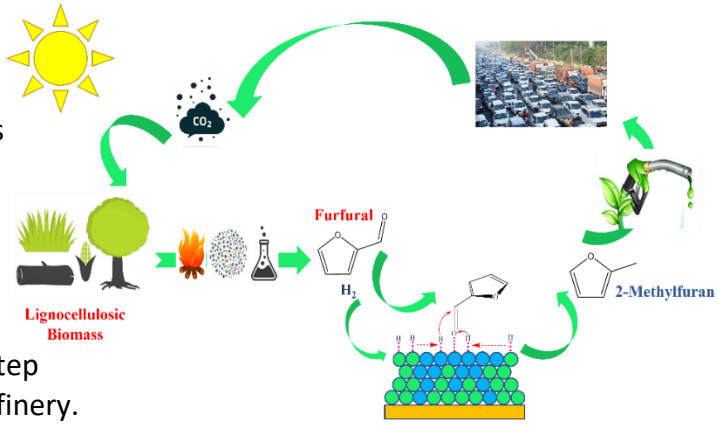
For further information of CSI please visit, http://www.catalysisindia.org, https://www.begellhouse.com/journals/catalysis-in-greenchemistry-and-engineering.html & https://www.linkedin.com/groups/13923122/

CSERL is developing highly active novel catalytic materials, such as perovskites, spinels, hydrotalcites, zeolites, and mixed metal oxides with their synergistic effects, for various chemical processes. Laboratory aim to improve the efficiency of chemical reactions and minimize the by-products' formation while ensuring that the materials used in the process are environmentally friendly.

CSERL has made notable achievements in the field of green hydrogen production using agricultural residue-derived bio-oil. The laboratory has explored transition metal-based perovskite catalysts to enhance hydrogen production while minimizing coke formation during the catalytic steam reforming process.

This research has yielded exceptional results, indicating that the use of perovskite catalysts can significantly improve hydrogen production, with reduced greenhouse gas emissions.

Furthermore, CSERL has also reported research on the production of 2-methyl furan (2MF) from furfural, a promising green platform chemical with tremendous potential in the field of biofuels. 2MF has proven to be an excellent candidate for blending with aviation fuel, thereby expanding its potential applications. The laboratory's research on the production of 2MF from furfural represents a crucial step towards achieving a more sustainable bio-refinery.



Overall, Catalysis and Sustainable Energy Research laboratory's efforts towards promoting sustainable energy production and catalysis using environmentally friendly materials have yielded promising results. The research findings represent a significant advancement towards the realization of a greener future.

Recent Publications:

- P.P. Singh, A. Jaswal, N. Nirmalkar, T. Mondal, Synergistic effect of transition metals substitution on the catalytic activity of LaNi0.5M0.5O3 (M = Co, Cu, and Fe) perovskite catalyst for steam reforming of simulated bio-oil for green hydrogen production, Renew. Energy. 207 (2023) 575–587. https://doi.org/10.1016/j.renene.2023.03.057.
- A. Jaswal, P.P. Singh, A.K. Kar, T. Mondal, R. Srivastava, Production of 2-methyl furan, a promising 2nd generation biofuel, by the vapor phase hydrodeoxygenation of biomass-derived furfural over TiO2 supported Cu Ni bimetallic catalysts, Fuel Process. Technol. 245 (2023) 107726. https://doi.org/10.1016/j.fuproc.2023.107726.
- A. Jaswal, P.P. Singh, T. Mondal, Furfural-a versatile, biomass-derived platform chemical for the production of renewable chemicals, Green Chem. 24 (2022) 510–551. https://doi.org/10.1039/d1gc03278j.

- P.P. Singh, N. Nirmalkar, T. Mondal, Catalytic steam reforming of simulated bio-oil for green hydrogen production using highly active LaNixCo1−xO3 perovskite catalysts, Sustain. Energy Fuels. 6 (2022) 1063–1074. https://doi.org/10.1039/d1se01786a.

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Commercial & Policies

- **Amplus Solar to set up distributed green hydrogen production plants in Andhra Pradesh**

Amplus Solar has entered a Memorandum of Understanding (MoU) with the Andhra Pradesh government to set up multiple decentralized green hydrogen production plants in the state. The company aims to set up 7.5ktpa distributed green hydrogen plants for industrial consumption in Andhra Pradesh with an investment of INR 1,500 crore into on-site hydrogen production plants and off-site wind and solar energy plants. Amplus Solar offers long-term profitable and clean energy solutions to commercial and industrial customers through setting up on-site and off-site renewable plants. Amplus owns and manages a portfolio of over 1.4+ GW of distributed solar assets and serves 350+ Indian and multinational firms, quadrupling its customer base from 2017 to 2023.
Source: https://www.pv-magazine-india.com/2023/03/22/amplus-solar-to-set-up-distributed-green-hydrogen-production-plants-in-andhra-pradesh/

- **L&T inks agreement with McPhy for electrolyser technology**

Under the partnership, McPhy will grant L&T an exclusive licence of its pressurised alkaline electrolyser technology, including future product upgrades.“L&T plans to set up a gigawatt-scale manufacturing facility for electrolysers based on McPhy technology to serve domestic requirements, as well as cater to other selected geographies,” the Mumbai-headquartered company said in a statement. Green hydrogen production capacity in India is estimated to grow to at least 5 million tonnes per annum (MTPA) by 2030 in line with the nation’s Green Hydrogen Mission, which would call for investments upwards of $100 billion.

Source: https://www.thehindubusinessline.com/companies/lt-inks-agreement-with-mcphy-for-electrolyser-technology/article66652116.ece

- **NTPC to Build Green Hydrogen Plants in Army Establishments**

NTPC Renewable Energy has inked a memorandum of understanding (MoU) to construct build-own-operate (BOO) green hydrogen projects in Army facilities. The goal is to hasten the decarbonization process while reducing complicated logistics and reliance on fossil fuels. The Indian Army uses DG units in off-grid regions to power various places. NTPC REL will gradually design, develop, and implement hydrogen energy storage systems and renewable energy projects (solar, wind, etc.). In accordance with the MoU, NTPC REL and the Indian Army will work together to identify appropriate locations for the gradual establishment of green hydrogen projects for the delivery of power.
Source: https://energynews.biz/ntpc-to-build-green-hydrogen-plants-in-army-establishments/

- **Tamil Nadu unveils 'Ethanol Blending Policy 2023**

The Tamil Nadu government unveiled its 'TN Ethanol Blending Policy 2023,' with a mission to improve farmer income, revive the sugar industry and to attract investments worth Rs 5000 crore in molasses/grain-based Ethanol production capacity. The targets for the policy term are "to be self-sufficient and meet the estimated Ethanol blending requirement of 130 crore litres.
Source:https://economictimes.indiatimes.com/industry/renewables/tn-unveils-ethanol-blending-policy-2023/articleshow/98759933.cms?from=mdr

- **Russian oil imports to India to hit a plateau**

From almost negligible imports about a year ago, Russia now accounts for more than one-third (39 per cent) of India's cumulative in-bound shipments, averaging monthly at almost 18 million tonnes in FY23 so far. Even as Russia is likely to maintain its position as India's top crude oil supplier, owing to the price advantage, the volume of imports from the erstwhile Soviet Union could hit a plateau going ahead.
Source: https://www.bqprime.com/economy-finance/indias-russian-oil-imports-hit-record-high-in-february

- **Hydrogen Gentech to develop PSA hydrogen purification Unit for Balaji Speciality**

Hydrogen Gentech P. Limited (HGPL) has been chosen by Balaji Specialty Chemicals Limited (BSCL), a subsidiary of Balaji Amines Limited, to design, engineer, manufacture, supply, and commission its Hydrogen Purification Unit (HPU). Using the methanol cracking process, the unit will produce high-purity hydrogen. The hydrogen purification process technology involves a process study of the composition of mixed gas received at the outlet of the methanol cracking reactor to produce high-purity hydrogen. This study determines the appropriate adsorbents needed to remove each impurity via adsorption and achieve the desired purity level of the hydrogen product. The PSA-based hydrogen purification system will consist of five towers that will operate cyclically in various stages of hydrogen generation and tower regeneration.
Source: https://www.indianchemicalnews.com/technology/balaji-speciality-chemicals-selects-hydrogen-gentech-to-develop-hydrogen-purification-unit-16861

- **Gevo enters joint development agreement with LG Chem to develop bio-propylene**

Gevo, Inc. and LG Chem, Ltd., a leading global chemical company committed to producing sustainable products, announced today that they have entered into a joint development agreement to develop bio-propylene for renewable chemicals using Gevo's Ethanol-to-Olefins (ETO) technology. Bio-propylene can be used to replace fossil-based products as an eco-friendly raw material for various plastic products and is expected to play a pivotal role in the rapid growth of the bioplastic market and circular economy. Once commercialization is achieved, bio-propylene could be used as a drop-in replacement for use in automobile interiors and exteriors, flooring, and diapers bio-propylene could be to replace petroleum products with bio-based materials with a low or negative carbon footprint.

Source: https://www.indianchemicalnews.com/petro-chemical/gevo-enters-joint-development-agreement-with-lg-chem-to-develop-bio-propylene-17109

- **Lummus and RWDC sign MoU to license PHA technology**

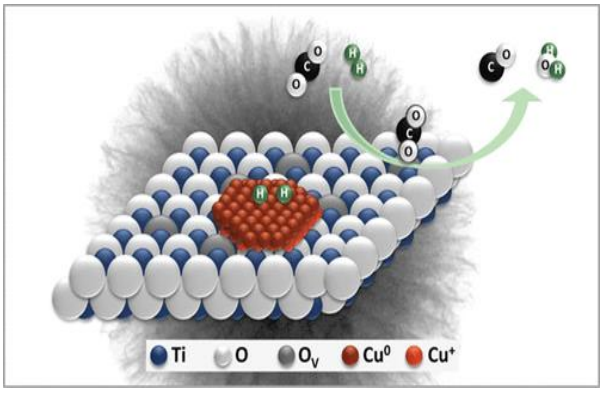
Lummus Technology and RWDC Industries recently signed a Memorandum of Understanding (MoU) to cooperate on global polyhydroxyalkanoates (PHA) deployment initiatives.

The MoU is an important step toward a joint development that will rapidly grow the manufacturing of PHA through global licensing opportunities. With Lummus' expertise in process technology and RWDC's expertise in PHA production and application, the partnership will significantly accelerate global availability and mass adoption of this natural alternative to synthetically produced petroleum-based plastics.

Source: https://www.hydrocarbonengineering.com/the-environment/13042023/lummus-and-rwdc-industries-sign-mou/

Scientific Updates

- **Strong Metal–Support Interactions in Copper on Defected TiO2 Catalysts for CO_2 Reduction**

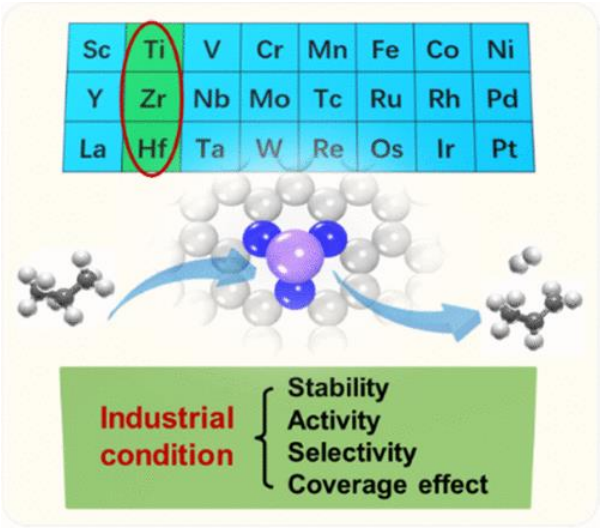


A highly active and stable Cu-based catalyst for CO_2 to CO conversion was demonstrated by creating a strong metal–support interaction (SMSI) between Cu active sites and the TiO_2-coated dendritic fibrous nano-silica (DFNS/TiO_2) support. The DFNS/TiO2–Cu10 catalyst showed excellent catalytic performance with a CO productivity of 5350 mmol g^{-1} h^{-1} (i.e., 53,506 mmol g Cu^{-1} h^{-1}), surpassing that of almost all copper-based thermal catalysts, with 99.8% selectivity toward CO. Even after 200 h of reaction, the catalyst remained active. Moderate initial agglomeration and high dispersion of nanoparticles (NPs) due to SMSI made the catalysts stable. Electron energy loss spectroscopy confirmed the strong interactions between copper NPs and the TiO_2 surface. In situ Raman and UV–vis diffuse reflectance spectroscopy studies provided

insights into the role of oxygen vacancies and Ti^{3+} centers, which were produced by hydrogen, then consumed by CO_2, and then again regenerated by hydrogen. Based on these observations, proposed a CO_2 reduction mechanism, which follows a redox pathway assisted by hydrogen.
Source: J. Am. Chem. Soc. 2023, https://doi.org/10.1021/jacs.3c01336

- **Comprehensive Mechanism and Microkinetic Model-Driven Rational Screening of 3N-Modulated Single-Atom Catalysts for Propane Dehydrogenation**

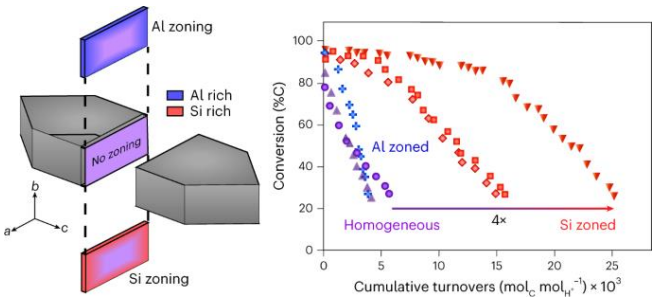
Direct propane dehydrogenation (PDH) is an economically competitive and environmentally friendly industrial scheme used to produce propylene. Beyond the traditional Pt or Cr oxide catalyst, in this study, 3N-coordinated transition-metal single-atom catalysts confined within capability for C–H activation. A total of 29 TM1-N3/C catalysts, covering the majority of 3d–5d transition metals, are systematically screened by first-principles mechanistic exploration and microkinetic modeling to assess their stability, activity, and selectivity; particularly, author considered the possible side reactions and the coverage effect of dominant intermediate for the realistic industrial applicationgraphene (TM1-N3/C) for PDH due to their open coordination configuration with tunable. Only six TM1-N3/C catalysts containing early TMs (TM = Sc, Ti, Y, Zr, La, Hf) are found to be stable at the working conditions of ~900 K, owing to the unsaturation of the 3N-coordinated single-atom structure. Moreover, the side reactions and the coverage effect are also demonstrated to be prominent. After a thorough consideration of all of the influencing factors, TM1-N3/C (TM = Ti, Zr, Hf) was found to be promising catalysts for practical applications with superior activities compared to the traditional Pt(111) catalyst.



Source: ACS Catal. 2023, 13, XXX, 5529–5537

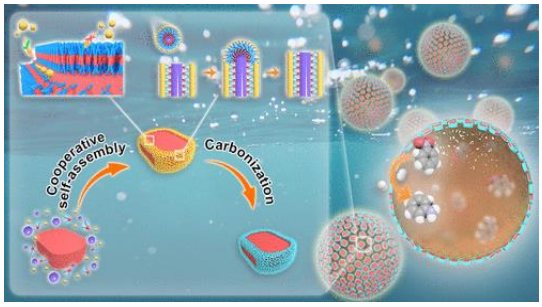
- **Elemental zoning enhances mass transport in zeolite catalysts for methanol to hydrocarbons**

Mass transport limitations in zeolite catalysts pose major hurdles for their optimal performance in diverse chemical reactions. Most approaches to reduce these restrictions focus on the synthesis of either hierarchical or nanosized zeolites. This work demonstrates that the existence of a siliceous, catalytically inactive exterior rim on ZSM-5 particles dramatically reduces the diffusion limitations, which leads to an enhanced catalyst lifetime for the methanol-



to-hydrocarbon reaction Our findings reveal that binary inorganic and organic structure-directing agents enable a one-pot synthesis of Si-zoned ZSM-5 catalysts with diffusion properties that are characteristic of particles with a much smaller size. Operando ultraviolet–visible light diffuse reflectance spectroscopy reveals a marked reduction in external coking among Si-zoned samples. Molecular dynamics simulations to assess the diffusion of methanol and benzene in siliceous pores and in those with Brønsted acids reveal substantially reduced transport limitations in zoned regions, consistent with the improved catalyst activity of Si-zoned zeolites relative to that of ZSM-5 with a homogeneous acid-site distribution.
Source: Nature Catalysis, 2023, 6, 254–265

- **Regioselective Surface Assembly of Mesoporous Carbon on Zeolites Creating Anisotropic Wettability for Biphasic Interface Catalysis**



A regioselective surface assembly strategy for the region-specific growth of mesoporous polymer/carbon on zeolite nanocrystals is reported. The approach enables controllable regioselective surface deposition of mesoporous polydopamine on the edges, curved surfaces, or/and flat surfaces of the silicalite-1 nanocrystals into exotic hierarchical nanostructures with diverse surface geometries. Upon carbonization, their derived heterostructures with anisotropic surface wettability show amphiphilic properties. As a proof of concept, Pt nanoparticle-encapsulated silicalite-1/mesoporous carbon nanocomposites are tested to be interface-active for forming Pickering emulsions. Significantly, the catalysts show superior catalytic performance in shape-selective hydrogenation of various nitroarenes in a series of biphasic tandem catalytic reactions, giving ∼100% yield of corresponding amine products.
Source: J. Am. Chem. Soc. 2023, https://doi.org/10.1021/jacs.3c00309

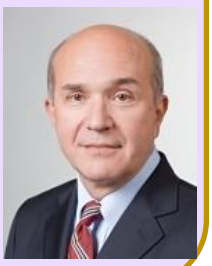
Catalysis Research out of India

1. H. Bajpai, I.Chauhan, K N Salgaonkar, N B Mhamane, C. S Gopinath, “Biomass components toward H 2 and value-added products by sunlight-driven photocatalysis with electronically integrated Au δ−–TiO 2: concurrent utilization of electrons and holes”, **RSC Sustainability, 2023,** DOI: 10.1039/D2SU00145D
2. Kranti N Salgaonkar, Sandip R Kale, Naresh Nalajala, Sayana Mansuri, Chinnakonda S Gopinath, “Selective and Generic Photocatalytic Oxidation of Alcohol with Pd−TiO2 Thin Films: Butanols to Butanal/Butanone with Different Morphologies of Pd and 0.5θPt-Pd Counterparts”,**Chemistry–An Asian Journal, 2023**, **https://doi.org/10.1002/asia.202201239**
3. Satish M Chauhan, B.M. Bhanage, “Metal-free synthesis of Quinazolinone from 2-amino benzonitrile in the presence of formic acid as a C1 source” **Tetrahedron Letters, 2023**, 154482

4. Shivani S Vedula, Ganapati D Yadav, "Treatment of wastewater containing alizarin red dye: development and application of magnetic chitosan as a natural eco-friendly material", **Clean Technologies and Environmental Policy**, **2023** 25, 865–878
5. Ayan Maity, Saideep Singh, Swati Mehta, Tristan GA Youngs, J. Bahadur, Vivek Polshettiwar "Insights into the CO2 Capture Characteristics within the Hierarchical Pores of Carbon Nanospheres Using Small-Angle Neutron Scattering" **Langmuir, 2023,** 39, 12, 4382–4393
6. Baljeet Singh, Vivek Polshettiwar,"Role of fiber density of amine functionalized dendritic fibrous nanosilica on CO2 capture capacity and kinetics" **Pure and Applied Chemistry, 2023, https://doi.org/10.1515/pac-2023-0103**
7. Rajesh Belgamwar, Rishi Verma, Tisita Das, Sudip Chakraborty, Pradip Sarawade, Vivek Polshettiwar, "Defects Tune the Strong Metal–Support Interactions in Copper Supported on Defected Titanium Dioxide Catalysts for CO_2 Reduction" **Journal of the American Chemical Society, 2023,** https://doi.org/10.1021/jacs.3c01336
8. Rochak Mittal, Vivek Ranade, "Bioactives from microalgae: A review on process intensification using hydrodynamic cavitation" **Journal of Applied Phycology, 2023,** 1-33 https://doi.org/10.1007/s10811-023-02945-w

Webinar Organized by Catalysis Society of India on 13th April 2023

The Catalysis Society of India, organized Webinar on" **Catalysis and water - Understanding the Potential for Central and Decentralized Conversions of Energy Carriers" by Prof. Johannes A. Lercher, Director, Institute for Integrated Catalysis,** Pacific Northwest National Laboratory, Richland, WA on 13th April 2023 The webinar was well appreciated & received huge response from academia, research laboratories and industries.



Announcements

- **Upcoming Symposium/Conferences/Seminars**

1. 6th International Oil & Gas Chemistry, Chemicals & Additives Conference (IOGCA 2023) from 12-13th September 2023 at Ahmedabad http://oilfieldchemical.org/
2. Catalysis Engineering & Technology (CET) meeting will be held from June-14-16, 2023 in Dubai, UAE along with The Catalysis Society of India (CSI) as Scientific Collaborator. **50% waive off on registration fee to CSI life members.**
3. The 28th North American Catalysis Society Meeting Providence, Rhode Island, June 18-23, 2023
4. May 29-June 02, 2023-E-MRS 2023 Spring Meeting of the European Materials Research Society, Strasbourg, France

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5. International Conference on Organometallics and Catalysis from 30th – 2nd Nov 2023 at Goa, India https://www.icoc2023.com
6. 2nd International Conference on Catalysis and Chemical Engineering, November 09-10, 2023 Millennium Hotel Paris Charles De Gaulle, Paris, France https://scisynopsisconferences.com/catalysis/

Achievements/Recognitions

CSI congratulates the following CSI members on the recognition they have received recently.

Name	Achievement
Prof. Biswajit Chowdhury Indian Institute of Technology, (ISM), Dhanbad, Jharkhand, INDIA 	Elected as Fellow of Indian Chemical Society (ICS) March 2023

Editorial Team

Dr. Sharad Lande

Dr. Raksh Vir Jasra

Quote of the Month

" Happiness is not something readymade; it comes from your own actions."
— The Dalai Lama

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