October 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.

Commercial & Policies

- **Mattiq Develops Portfolio of Novel Catalysts to Solve Key Materials Challenge in the Global Scale-Up of Clean Hydrogen**

Mattiq the clean chemistry company, announced today the development of a portfolio of novel, highly durable alternatives to Iridium, a rare and costly element critical to clean hydrogen production. Each alternative has the potential to meet or exceed that material's performance, but with a much lower cost and greater availability.
Source: https://www.businesswire.com/news/home/20231003314654/en/Mattiq-Develops-Portfolio-of-Novel-Catalysts-to-Solve-Key-Materials-Challenge-in-the-Global-Scale-Up-of-Clean-Hydrogen

- **Dr. Raksh Vir Jasra Declared Winner of International Gulf Energy Excellence 2023 Life Time Achievement Award**

Dr. Raksh Vir Jasra (Senior Vice President, Reliance Technology Group, Vadodara, Reliance Industries Ltd.) is declared winner of the International Gulf Energy Excellence 2023 Life Time Achievement Award at Houston, USA on 11th October 2023 for research, innovation and technology commercialization. **He is the first person from India to receive this honor.**
The recipient of several national and international awards, Dr. Jasra is a world-renowned Adsorption and Catalysis scientist who has been involved in developing developed 66 chemical processes, of which 27 were commercialized in Industry; 27 were demonstrated up to pilot plant; and 12 were developed at lab scale.
Dr. Jasra has published 325 research articles in National and International journals, 10 chapters in books, and 15 scientific articles. He has 316 granted patents, including 68 US 149 Indian and 99 in the other countries.

He is Fellow of Indian National Science Academy, Indian National Academy of Engineering & Gujarat Science Academy & also receipt of Life Time Achievement Award 2020 by Indian Chemical Society.
Source: //worldoil.com/news/2023/10/11/2023-gulf-energy-information-excellence-award-winners-honored-at-live-houston-gala/?oly_enc_id=1249B4872812A8U

- **ONGC mulls $20-bn investment in two petrochemical facilities**

Oil and Natural Gas Corporation Limited (ONGC) is planning to invest Rs 20 billion for setting up two petrochemical plants across the country. Currently, it is looking for land for setting up the projects. The projects would either be set up independently or as a joint ventures (JV). Besides, it is also planning to set up two greenfield oil to chemical plants in the country for converting crude oil to petrochemicals. The company aims to expand its chemical and petrochemical portfolio from the present 4.2 mtpa to 8 mtpa by 2030.
Source: https://indianinfrastructure.com/2023/10/06/ongc-plans-to-invest-rs-20-billion-in-two-petrochemical-projects/

- **British International Investment (BII) eyes $1-bn investment in Indian clean energy projects**

BII invested over $300 million in climate finance last year in sectors such as renewable energy, electric mobility and sustainable agriculture in India. Its' current portfolio in India is valued at $2.2 billion with investment in over 290 businesses. Last year, BII agreed to invest up to $250 million in automaker Mahindra and Mahindra Ltd's (MAHM.NS) new electric vehicle unit. India has produced the best returns of any geography we have invested in," said O'Donohoe, citing buoyant stock markets and a stable political environment in the country.
https://www.reuters.com/sustainability/british-international-investment-eyes-1-bln-investment-india-clean-energy-2023-09-26/

- **Essar Oil UK selects Mitsubishi Heavy Industries as technology licensor for EET Industrial Carbon Capture**

Essar Oil UK Limited (EOUK), the leading integrated downstream energy company, announces that it has completed the selection of a key licensor technology provider and signed a contract for the development of the required basic engineering design package for its new EET Industrial Carbon Capture facility based at Stanlow, UK. This is a leading use of carbon capture technology, associated with a fluid catalytic cracker within refineries globally.
Essar will achieve its decarbonization targets through a combination of incremental transformational projects, including energy efficiency and EET Industrial Carbon Capture and, as a result of the significant investments it is making into hydrogen and biofuels, via Essar Energy Transition (EET). Ultimately, the company expects to achieve a 75% reduction in emissions by 2030 and be net zero by 2040.
Source: https://www.essar.com/essar-oil-uk-selects-mitsubishi-heavy-industries-as-technology-licensor-for-eet-industrial-carbon-capture/

- **BASF becomes first company to successfully produce metal-organic frameworks on a commercial scale for carbon capture**

BASF is the first company to produce metal-organic frameworks (MOFs) on a production scale of several hundred tons per year. MOFs are highly crystalline structures with nanometer-sized pores and a large surface area. This structure offers a high capacity for the storage of carbon dioxide (CO_2), the dehumidification of air for room climate control, and the adsorption of the greenhouse gas methane. BASF has developed expertise on the scale-up and production of MOFs, can tailor MOFs to customers' needs and specifications, and today has the capacity to produce customized MOFs for various applications and industries.
Source: https://www.basf.com/global/en/media/news-releases/2023/10/p-23-327.html

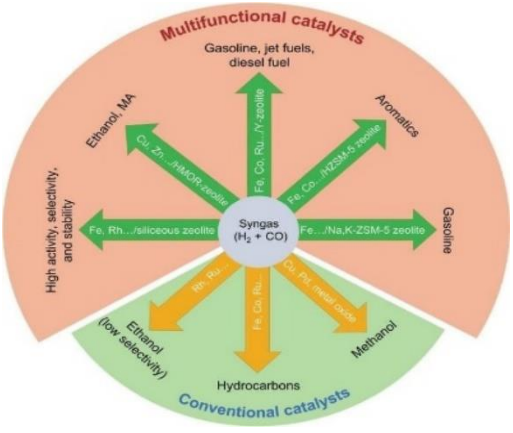
- **India and Saudi Arabia sign MoU in green/ clean hydrogen and supply chains**

India and Saudi Arabia have signed a Memorandum of Understanding in Riyadh in the fields of Electrical Interconnections, Green / Clean Hydrogen and Supply Chains. This MoU aims to establish a general framework for co-operation between the two countries in the field of electrical interconnection; exchange of electricity during peak times and emergencies; co-development of projects; co-production of green / clean hydrogen and renewable energy; and also establishing secure, reliable and resilient supply chains of materials used in green / clean hydrogen and the renewable energy sector.
Source: https://www.indianchemicalnews.com/hydrogen/india-and-saudi-arabia-sign-mou-in-green-clean-hydrogen-and-supply-chains-19108

Scientific Updates

- **Zeolite's Significance in Syngas Conversion Catalysts**

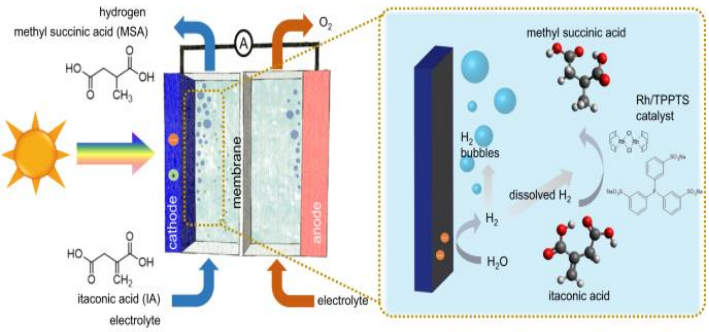
A team of researchers have evaluated the advances in synthetic gas conversion with zeolites-containing catalysts to better understand how zeolites govern the reaction pathways. Scientists discovered that zeolite efficiently optimizes reaction routes beyond the standard FTS approach. Zeolites are hydrated aluminosilicates solids with a three-dimensional crystal structure that allows them to efficiently absorb and expel liquid. Scientists have used zeolites to increase the selectivity of gasoline, jet fuel, and diesel. These results outperform those obtained with the Anderson-Schulz-Flory model. Using zeolite catalysts, they have also produced a number of aromatic compounds.



Source: Li, H., et al. (2023) Importance of zeolite in multifunctional catalysts for syngas conversion. Carbon Future. doi:10.26599/CF.2023.9200003

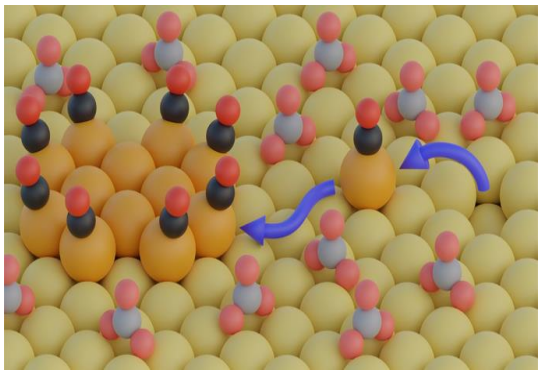
- **Solar-driven upgrading of biomass by coupled hydrogenation using in situ (photo)electrochemically generated H_2**

Authors demonstrate the in situ use of (photo)electrochemically generated H_2 for the homogeneous hydrogenation of itaconic acid a biomass-derived feedstock to methyl succinic acid. Coupling these two processes offers major advantages in terms of stability and reaction flexibility compared to direct electrochemical hydrogenation, while minimizing the overpotential. An overall conversion of up to ~60% of the produced hydrogen is demonstrated for our coupled process, and a techno-economic assessment of our proposed device further reveals the benefit of coupling solar hydrogen production to a chemical transformation.



Source: Nature Communication **14**, 6017 (2023). https://doi.org/10.1038/s41467-023-41742-4

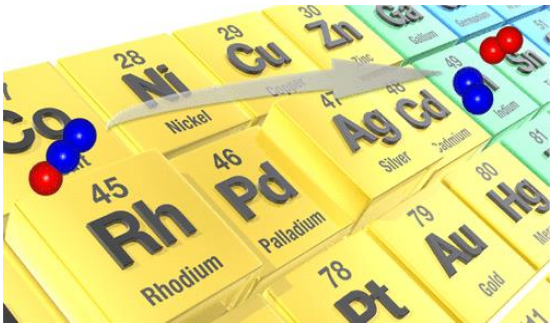
- **Atomic-scale surface restructuring of copper electrodes under CO_2 electroreduction conditions**



Potentiodynamic methods that induce structural changes in Cu catalysts for the electrochemical reduction of CO_2 (CO_2RR) have been identified as a promising strategy for steering the catalyst selectivity towards the generation of multi-carbon products. In current approaches, active species are created via a sequential Cu oxidation reduction process. Here we show by in situ scanning tunneling microscopy, surface X-ray diffraction and Raman spectroscopy measurements that low-coordinated Cu surface species form spontaneously near the onset of CO_2 electrocatalytic reduction. This process starts by CO-induced Cu nanocluster formation in the initial stages of the reaction, leading to irreversible surface restructuring that persists over a wide potential range. On subsequent potential increase, the nanoclusters disperse into Cu adatoms, which stabilize reaction intermediates on the surface. The observed self-induced formation of undercoordinated sites on the CO_2-converting Cu catalyst surface can account for its reactivity and may be exploited to (re)generate active CO_2RR sites by potentiodynamic protocols.

Source: Nature Catalysis 6, 837–846 (2023). https://doi.org/10.1038/s41929-023-01009-z

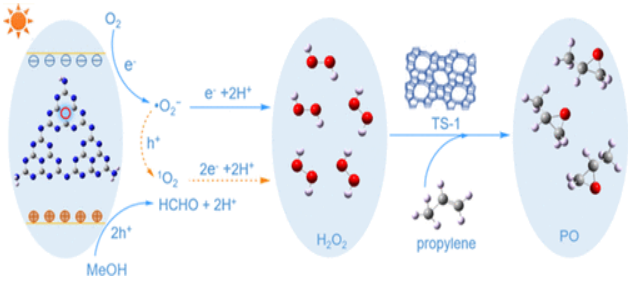
- **Promotional Effect of Ag on the Catalytic Decomposition of N_2O in the Presence of O_2 over the Al_2O_3-Supported Rh Catalyst**



Supported RhOx catalysts are known to show high efficiency for N_2O decomposition, even in the presence of O_2, compared with other materials, such as supported metal oxides and Fe-based zeolite catalysts. In reported study, the addition of Ag was found to enhance the efficiency of an Al_2O_3-supported RhOx catalyst ($RhOx/Al_2O_3$) for N_2O decomposition. The promotional effect of Ag was investigated using various operando spectroscopic methods, including X-ray absorption spectroscopy, diffuse reflectance UV–vis spectroscopy (DR UV–vis), ambient-pressure X-ray photoelectron spectroscopy, and kinetic studies. The results demonstrated that the addition of Ag enhanced the catalytic efficiency of the supported RhOx catalysts by enhancing the thermal reduction of Rh oxide, which was identified as the rate-determining step, especially at low temperatures.

Source: ACS Catalysis 2023, 13, 19, 12983–12993

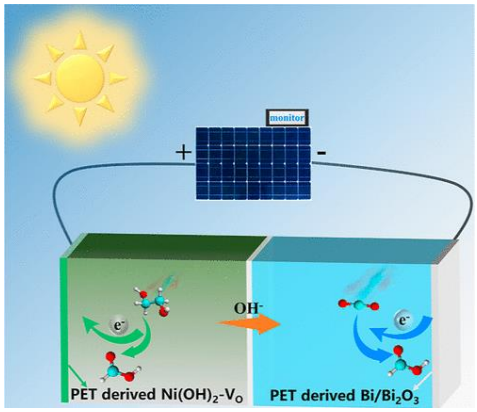
- **Boosting C_3H_6 Epoxidation via Tandem Photocatalytic H_2O_2 Production over Nitrogen-Vacancy Carbon Nitride**



Authors constructed a tandem system for photocatalytic in situ H_2O_2 production and propylene epoxidation. In this tandem transformation system, prepared carbon nitride containing N3C vacancies in one step by the synergistic action of argon pyrolysis and a supramolecular self-assembly precursor. The introduction of N3C vacancies significantly promoted the photogenerated electron–hole separation and enhanced the adsorption of H+ and O2 for excellent photocatalytic H_2O_2 performance (5775 µmol/g/h) via the dual paths involving ·O2– and 1O2. To avoid the separation and purification of H_2O_2, a compatible solvent system consisting of methanol and water was utilized to promote the production of both H_2O_2 and PO. Benefiting from them, the PO production efficiency came to 5515 µmol/g/h with a selectivity of 99.1%. This work not only opened up an idea for propylene epoxidation using O_2 but also provided a reference for creating more propylene epoxidation systems in series with photosynthetic H_2O_2.

Source: ACS Catalysis, 2023, 13, 19, 13101-13110

- **Electrocatalytic Waste-Treating-Waste Strategy for Concurrently Upgrading of Polyethylene Terephthalate Plastic and CO_2 into Value-Added Formic Acid**



Present work reports an electrocatalytic waste-treating-waste strategy for concurrently upgrading PET plastic and CO_2 wastes into value-added formic acid (HCOOH), in which both the anode (oxygen-vacancy-rich $Ni(OH)_2$-VO) and cathode (Bi/Bi_2O_3 heterostructure) electrocatalysts were elaborately designed from PET derivatives. Impressively, the as-prepared $Ni(OH)_2$-VO and Bi/Bi_2O_3 achieve high selectivity of HCOOH (86 and 91%, respectively) with industrial-level current densities at ultralow potentials (300 mA cm^{-2} at 1.6 V and −272 mA cm–2 at −1.4 V, respectively). Further experimental and theoretical results reveal that the abundant oxygen vacancies will largely facilitate the formation of Ni^{3+} species and accelerate the subsequent processes of dehydrogenation and C–C bond breakage during PET upcycling. Meanwhile, the interface electron transfer from Bi_2O_3 to Bi benefits the keeping of high valence of Bi sites and optimizes the adsorption of OCHO* intermediate, thereby endowing Bi/Bi_2O_3 with efficient performance toward CO_2 reduction to HCOOH. As a proof of concept, a solar-powered flow reactor with real-time monitoring and control functions was designed, which realized a record Faradaic efficiency of 181 % for HCOOH. This work offers opportunities for waste utilization and provides constructive guidance for the design of advanced electrocatalysts for converting wastes into valuable chemicals.

Catalysis Research out of India

1. Henilkumar M. Lankapati , Dharmesh R. Lathiya , Lalita Choudhary , Ajay K. Dalai, Kalpana C. Maheria, " Modification and characterization of Mordenite zeolite derived from waste coal fly ash and its application as a heterogeneous catalyst for the n-butyl levulinate synthesis" Catalysis Communications, **Catalysis Communications, 2023,** 183, 106772
2. Aayushi Lodhi, Kalpana C. Maheria, "Solid acid catalysed synthesis of biologically potent quinazolinones: Environmentally benign approaches" **Sustainable Chemistry and Pharmacy 2023,** 36, 101265
3. Chandra Shobha Vennapoosa, Sagar Varangane, Spandana Gonuguntla, B Moses Abraham, Mohsen Ahmadipour, Ujjwal Pal, "S-Scheme ZIF-67/CuFe-LDH Heterojunction for High-Performance Photocatalytic H2 Evolution and CO2 to MeOH Production" **Inorg. Chem. 2023**, 62, 40, 16451–16463
4. Mohsen Ahmadipour and Ujjwal Pal Amit Gautam, Saddam Sk, Aparna Jamma, Moses Abraham Bokinala, "Colloidal Synthesis of Heterostructured CuCo2S4/g-C3N4/In2S3 Nanocomposite for Photocatalytic Hydrogen Evolution" **Energy Adv., 2023,** 2, 1512-1520
5. Nageshwarrao Chanda, Manoj Kumar Saini, Ashok K Basak, Yarasi Soujanya, Sreedhar Bojja, Ujjwal Pal Shedding Light on Benzo[d]pyrrolo[2,1-b]thiazole-3-carbonitrile Sensitizer-Based TiO2 Photocatalysts for Enhanced Hydrogen Generation, **The Journal of Physical Chemistry C 2023**, 127, 36, 17654–17662

6. Ashish D Shejale, Ganapati D Yadav, "Steam reforming of bio-alcohols over Ni-M (Cu, Co, Pt)/MCF-S (MgO, La2O3, CeO2) for renewable and selective hydrogen production: Synergistic effect of MCF silica and basic oxides on activity and stability profiles" **Catalysis Today, 2023** 423, 113934
7. Quang Khanh Nguyen, Dinh Thi Nguyen, Thi Mai Anh Pham, Bach Pham, Thi Anh Huong Nguyen, Tien Duc Pham, Shuchi Sharma, Duc Thang Pham, Ranga Rao Gangavarapu, Thi Ngoc Mai Pham, "A highly sensitive fluorescence nanosensor for determination of amikacin antibiotics using composites of carbon quantum dots and gold nanoparticles" **Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy,** 2024, 305, 123466
8. RB Harikrishna, Hemagni Deka, T Sundararajan, G Ranga Rao, "Green hydrogen production by water splitting using scrap metals at high temperature" **International Journal of Hydrogen Energy 2023,** https://doi.org/10.1016/j.ijhydene.2023.08.366
9. Book on Advances in **Microwave-assisted Heterogeneous Catalysis** edited by Edited by **Jianli Hu**,West Virginia University, USA and **Benjaram M. Reddy,**BITS Pilani, Hyderabad Campus, India published by The Royal Society of Chemistry 2024.

RSC Book - Advances in Microwave-assistec

Upcoming Symposium/Conferences/Seminars/Workshop

1. Workshop on **Functional Materials & Heterogenous Catalysis** from 11th-15th, December, 2023 at IIT (ISM) Dhanbad. The details are available on https://gian.iitkgp.ac.in/GREGN/index
2. International Conference on Organometallics and Catalysis from **30th – 2nd Nov 2023** at Goa, India https://www.icoc2023.com
3. 2nd International Conference on Catalysis and Chemical Engineering, November 09-10, 2023 Millennium Hotel Paris Charles De Gaulle, Paris, France https://scisynopsisconferences.com/catalysis/
4. 17th Edition of International Conference on Catalysis, Chemical Engineering and Technology" (Catalysis 2023) as Hybrid Event during **October 26th-28th, 2023,** at Boston, Massachusetts, USA.
5. Industrial Green Chemistry World (IGCW-2023) – Convention & Ecosystem, on 7th & 8th Nov '23 at Hotel Westin Mumbai Garden City, Goregaon (E), Mumbai.
6. **January 31-February 01, 2024-**Future of Chemical Recycling 2024, Rotterdam, Netherlands
7. 18th International Congress on Catalysis from July 14-19, 2024, LYON, France.
8. International Conference on Catalysis, Chemical Science & TECHNOLOGY 2023 HYBRID from Nov 8th-10th, 2023 at Singapore.
9. 10th UK CATALYSIS CONFERENCE from 3rd-5th January, 2024 at HOLYWELL PARK, LOUGHBOROUGH, UK
10. XXIII International Symposium on Homogeneous Catalysis at Trieste, July 21-26, 2024

Conference/Webinar Organized by Catalysis Society of India

- **SusChemE 2.0,** International Conference on Sustainable Chemistry & Engineering 2023 is organized in the honor of Padma Shri Professor G.D. Yadav celebrating his excellence in Chemical Engineering research in Institute of Chemical Technology (ICT) Mumbai, India along with **the Catalysis Society of India** during **14th -16th September 2023** with the core theme "Catalyzing Research & Technovation For A Sustainable Future".

The conference was attended by more than 400 people, included very enlightening and engrossing talks by experts in catalysis from both the industry and academia as well as research students from various universities and institutes.

- **The Catalysis Society of India** organized a webinar on 17th October 2023 "**Bridging the Gap Between Well Defined and Industrial Catalyst via a Molecular Approach" by Prof. Christophe Copéret,** Department of Chemistry and Applied Biosciences – ETH Zürich, Switzerland. The webinar is attended by eminent scientists from academia and industry as well as research students.

Announcements

- **CSI welcome the following newly joined life members.**

Sr. No.	Member Name	Life Membership Number
1	Dr. Priyanka Verma	LM1103
2	Dr. Phani Brahma Somayajulu Rallapalli	LM1104
3	Dr. Selvamani A	LM1105
4	Dr. ANUP TATHOD	LM1106
5	Dr. Rupak Kishor	LM1107
6	Dr. Piyush Pratap Singh	LM1108

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/

- **CSI Congratulates the following CSI members on the recognition they received recently.**

Name	Achievements
Dr. Raksh Vir Jasra, *FNA, FNAE* Senior Vice President & Head, Reliance Technology Group, Reliance Industries Ltd. Vadodara, India, & President, Catalysis Society of India 	▪ Gulf Energy Excellence 2023 Life Time Achievement Award-Downstream
Padma Shri Professor Ganapati D. Yadav, *FTWAS, FNA, FNASc, FRSC (UK), FIChemE (UK), FIIChE* Emeritus Professor of Eminence & Former Vice Chancellor & R.T. Mody Distinguished Professor J.C. Bose National Fellow (Govt. of India), ICT Mumbai 	▪ "The EEF Global Excellence Awards 2023" in Hydrogen Sector ▪ FII Diamond Jubilee International Technology & Innovations Excellence Awards 2023

Quote of the Month

"If you cannot do great things, do small things in a great way."

- Napoleon Hill

Editorial Team

Dr. Sharad Lande

Dr. Raksh Vir Jasra

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