November 15, 2021

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 on Centre of Excellence in Catalysis Research in different Indian academics, research laboratories or industrial organizations. You may send your brief write-up to us which will be published in coming issues of CSI.

Commercial & Policies

- **First Propane Dehydrogenation (PDH) Plant in India**

GAIL (India) Limited has selected Lummus Technology's CATOFIN process and Clariant's tailor-made catalysts for India's first PDH plant. Its upcoming 500 kiloton per annum propane dehydrogenation facility in Usar, Maharashtra, will be integrated with a downstream polypropylene (PP) unit. The U.S. $1.2 billion PDH-PP project is expected to start operations by 2024. Source: PR Newswire, 10/21/2021.

Catalytic propane dehydrogenation is being growingly used to produce propylene which otherwise had been produced through steam crackers or FCC. There are approximately commercial 22 PDH units running Worldwide. More than 30 new PDH plant with a capacity of more than 30 million tons per year are currently under construction or planned for the coming year. ----- CSI

- **Bagasse to Ethanol Project in India**

Spray Engineering Devices Limited (SED) is partnering with LanzaTech in a first of a kind bagasse to ethanol project in India. To convert the solid biomass wastes to gases, LanzaTech will work with commercially proven gasification technology. The resulting carbon rich gas will then be converted to ethanol using LanzaTech's commercially proven gas fermentation platform. The integrated technology will have the flexibility to process a wide range of biomass feedstocks enabling rapid replication at other locations. Source: Lanzatech, 10/22/2021.

- **Govt Aims to Expand Domestic Ethanol Industry to Rs 2 Lakh Crore**

Mr Nitin Gadkari, Minister of Road Transport and Highways, Govt of India said that to reduce pollution levels in the country, the Government is aiming at an INR 2 lakh crore ethanol economy from its present size of INR 20,000 crore as the development of an extensive ethanol industry would mean new markets for the country's biomass and agriculture sector. Mr Gadkari

highlighted that the flex-fuel vehicles will play a crucial role to decarbonize the transport sector. "We are going to make it compulsory for all vehicle manufacturers to make flex-fuel engines that can run on more than one fuel to reduce pollution," said Mr Gadkari.
https://www.business-standard.com/article/news-cm/govt-aims-to-expand-domestic-ethanol-industry-to-rs-2-lakh-crore-nitin-gadkari-121101100423_1.html

One striking advantage of ethanol over other fuel sources is that it does not cause pollution to the environment. Using ethanol fuel to power automobiles results in significantly low levels of toxins in the environment. ---- CSI

- **India Set to Achieve 450 GW Renewable Energy Installed Capacity by 2030: MNRE**

India is set to achieve 450 GW of renewable energy installed capacity by 2030 as per The Ministry of New and Renewable Energy (MNRE), India. Earlier this month, the MNRE, in partnership with FICCI, organized a series of events, from October 6-8 during the Climate and Biodiversity Week at Expo 2020 Dubai. The events covered themes like 'India's Renewable Energy Achievements and Ambitions, Emerging Areas and Opportunities for Renewable Energy in India. The events were anchored by the Solar Energy Corporation of India (SECI) and the Indian Renewable Energy Development Agency (IREDA).
https://www.indiatoday.in/india/story/india-450-gw-renewable-energy-installed-capacity-2030-mnre-1863724-2021-10-12

Catalysis for renewable energy is one of the critical areas of development to respond to societal needs which further demonstrate the link between catalysis, innovation, and sustainability. --- CSI

- **India's Decarbonization Journey Poses $15tn Economic Opportunity by 2070**

India's decarbonization journey represents upwards of a $15 trillion economic opportunity by 2070 with the potential to create as many as 50 million net new jobs, said a World Economic Forum (WEF) report. The report 'Mission 2070: A Green New Deal for a Net-Zero India' provides a roadmap for India's transition to a low-carbon economy as it moves away from agriculture and services to manufacturing and a greener economy. The five pillars energy, mobility, industry, infrastructure and cities, and agriculture contribute to over 90% of India's greenhouse gas emissions, it said, adding India will need to address these pillars, alongside four cross-sectoral enablers, as part of its green transition. Source: The Times of India, 11/8/2021.

- **Praj Industries signs MoU with Indian Oil Corporation**

Praj Industries and Indian Oil Corporation have inked an MoU to explore opportunities to fast-track India's transition to cleaner and greener sources of energy by exploring avenues such as the production of Alcohol to Jet (ATJ) fuels, 1G & 2G Ethanol, Compressed Bio-Gas (CBG) and related opportunities in the Biofuels industry. Exploring these green energy horizons will be crucial for India to achieve carbon neutrality by 2070.

https://www.business-standard.com/article/news-cm/praj-industries-signs-mou-with-indian-oil-corporation-121110900569_1.html

- **Sumitomo Moves to Commercialize CO_2-Derived Bio-Ethylene**

Sumitomo is partnering with Cemvita for the commercialization the technology to produce ethylene from CO_2 using Cemvita's microorganisms. Cemvita is capable of creating microorganisms that efficiently absorb CO_2 and methane to produce high value-added chemicals. With the cemvita's technology able to produce more than 30 chemicals from CO_2 at normal temperatures and pressure. has the potential to contribute to the low-carbon production of not just ethylene but also various other chemical products. Sumitomo is particularly interested in an ethylene production process in which ethylene is produced from CO_2 via glucose, an intermediate product. This process can produce 450,000 tons of ethylene from 1.7 million tons of CO_2 and compared to the conventional process, it can reduce CO_2 emissions by several dozen percent while still being cost-competitive. Source: Japan Chemical Daily, 11/5/2021.

Scientific Updates

- **The Nobel Prize in Chemistry 2021 for OrganoCatalysis**

Catalysts are thus fundamental tools for chemists, but researchers long believed that there were, in principle, just two types of catalysts available: metals and enzymes.

Benjamin List and David MacMillan are awarded the Nobel Prize in Chemistry 2021 because in 2000 they, independent of each other, developed a third type of catalysis. It is called asymmetric organocatalysis and builds upon small organic molecules.

Organic catalysts have a stable framework of carbon atoms, to which more active chemical groups can attach. These often contain common elements such as oxygen, nitrogen, sulphur, or phosphorus. This means that these catalysts are both environmentally friendly and cheap to produce.

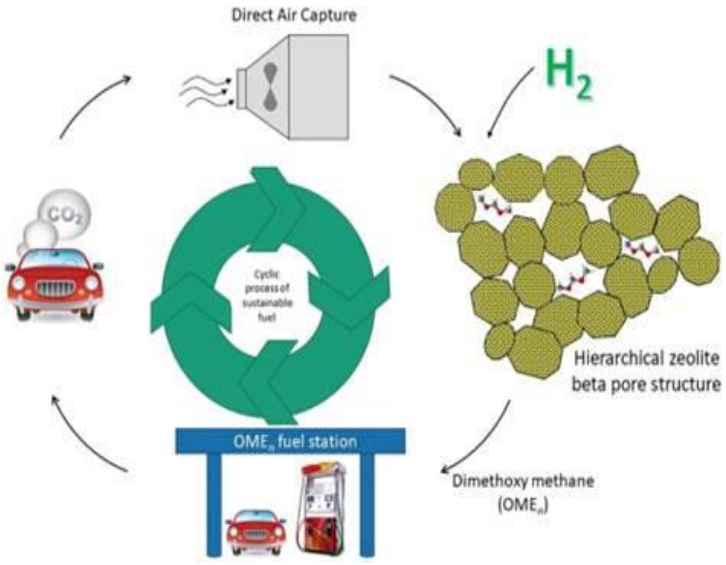
The rapid expansion in the use of organic catalysts is primarily due to their ability to drive asymmetric catalysis. When molecules are being built, situations often occur where two different molecules can form, which just like our hands are each other's mirror image.

Organocatalysis has developed at an astounding speed since 2000. Benjamin List and David MacMillan remain leaders in the field and have shown that organic catalysts can be used to drive multitudes of chemical reactions. Using these reactions, researchers can now more

efficiently construct anything from new pharmaceuticals to molecules that can capture light in solar cells. In this way, organocatalysts are bringing the greatest benefit to humankind. Source: https://www.nobelprize.org/prizes/chemistry/2021/press-release

- **Monash/Hokkaido Team Produces Diesel Blend Fuel via CO_2 Hydrogenation in Methanol Over New Catalyst**

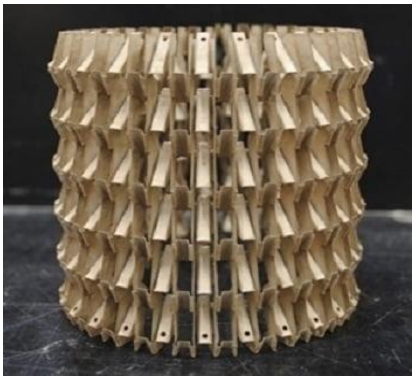
Researchers from Monash University and Hokkaido University have developed a method to produce dimethoxymethane (DMM) a diesel blend fuel currently of great research interest via CO_2 hydrogenation in methanol over a novel ruthenium-based catalyst. DMM thus produced could be used as a fuel in a conceptual circular carbon cycle when produced using direct-air-capture CO_2 and green hydrogen.



DMM, which is the simplest form of an OME, can be produced commercially via a two step-process of methanol oxidation to make formaldehyde, followed by coupling with methanol. However, currently, both methanol and formaldehyde are mainly produced from natural gas. In the new method, carbon dioxide, hydrogen and methanol are used as a feedstock for producing DMM in a single reactor. The team developed a novel catalyst based on ruthenium nanoparticles which make this reaction possible. An added advantage is that this reaction takes place at much lower temperatures than conventional methanol and formaldehyde production methods, making it significantly more energy efficient. Monash engineers are also working on a methanol synthesis method from carbon dioxide and hydrogen, closing the carbon loop to renewables only. The project has recently received funding for further research into the industrialization and scale-up of the catalyst and process by the Hindustan Petroleum Corporation Limited (HPCL), India. Source: Green Car Congress, 10/8/2021

- **Honeywell, ZFRT to Partner on Structured Catalyst for H_2 Production**

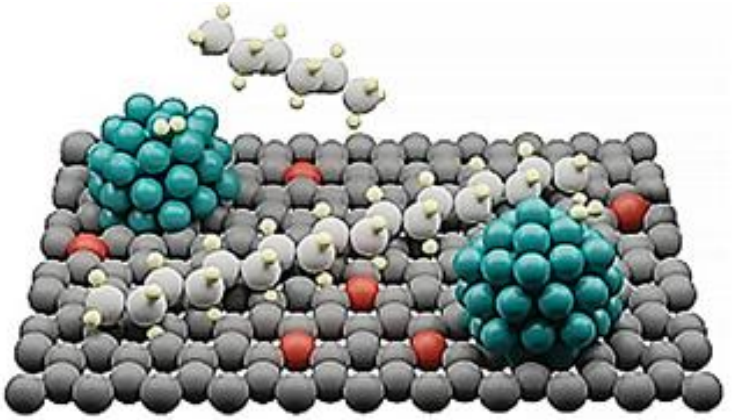
Honeywell and ZoneFlow Reactor Technologies (ZFRT) unveiled a joint agreement to commercialize ZoneFlow Reactor Technology. This technology promises to provide a step-change improvement in the efficiency and carbon intensity of steam methane reforming to produce hydrogen.



When coupled with Honeywell H_2 Solutions' carbon capture for hydrogen production, the ZoneFlow technology will make low-carbon hydrogen production more efficient and less expensive. The ZoneFlow Reactor, a structured catalyst module that replaces conventional catalyst pellets in SMR tubes, provides far superior heat transfer and pressure drop performance. UOP and ZFRT will cooperate in conducting reactive testing in ZFRT's large-scale pilot plant at Université Catholique de Louvain in Louvain-la-Neuve, Belgium. The reactive testing will validate the expected 15% increase in throughput over conventional catalyst pellet systems. Results from the pilot plant testing are expected to be available by mid-2022. Source: Gulf Energy, 11/2021.

- **Platinum Catalyst Turns Polypropylene into Motor Oil**

A new platinum catalyst converts PP plastic into valuable liquid hydrocarbons, primarily motor oil. Supported on carbon, platinum nanoparticles catalyze the degradation of the polymer, but the new surface is engineered to stop breaking the chains at a target size. The key to this new approach is oxygen. By exposing the carbon surface to different concentrations of an oxidant, the team tuned the number of oxygen atoms in the surface lattice. Varying the degree of oxygenation leads to different outcomes by regulating adsorption and desorption processes. Less surface oxygen forces molecules to stick longer, yielding smaller hydrocarbons like gases, while a highly oxidized catalyst prevents the reaction from happening at all.



Platinum nanoparticles on a carbon surface catalyze the degradation of polypropylene into shorter chain molecules the length of those found in motor oil (80%), diesel (15%), and gasoline (5%). The degree of oxygenation of the catalyst surface drives how long the polypropylene adheres to it, which determines the chain length of the products. (Pt=teal; C on surface=gray; oxygen=red; C in polypropylene=white; H=yellow). Credit: ChemSusChem

Source: ChemSusChem 2021, DOI: 10.1002/cssc.202101999).

Catalysis Research out of India

1. Harshada M Salvi & Ganapati D Yadav "Organic-inorganic epoxide hydrolase hybrid nanoflowers with enhanced catalytic activity: Hydrolysis of styrene oxide to 1-phenyl-1, 2-ethanediol" **Journal of Biotechnology,** 2021, 341, 113-120.
2. Gunjan Deshmukh & Ganapati D Yadav, "Tuneable transesterification of glycerol with dimethyl carbonate for synthesis of glycerol carbonate and glycidol on MnO2 nanorods and efficacy of different polymorphs" **Molecular Catalysis,** 2021, 515, 111934.
3. Baljeet Singh, Manoj B. Gawande, Arun D. Kute, Rajender S. Varma, Paolo Fornasiero, Peter McNeice, Rajenahally V. Jagadeesh, Matthias Beller, and Radek Zbořil "Single-Atom (Iron-Based) Catalysts: Synthesis and Applications" **Chemical Reviews, 2021, DOI: 10.1021/acs.chemrev.1c00158**
4. Aditi Sharma, Ranjana Dixit, Shivani Sharma, Sriparna Dutta, Sneha Yadav, Bhavya Arora, Manoj B. Gawande, Rakesh K Sharma "Efficient and sustainable Co3O4 nanocages based nickel catalyst: A suitable platform for the synthesis of quinoxaline derivatives" **Molecular Catalysis,** 2021, 504, 111454.
5. Preeti Sahu, Adarsh Sahu, Ayyamperumal Sakthivel "Cyclocondensation of Anthranilamide with Aldehydes on Gallium-Containing MCM-22 Zeolite Materials" **ACS Omega,** 2021, 6, 43, 28828–28837.
6. Satish Kumar, Prakash Kumar, Raksh Vir Jasra "Sorption of HCl from an Aromatic Hydrocarbon Mixture Using Modified Molecular Sieve Zeolite 13X" **ACS Omega,** 2021, 6, 43, 28742–28751
7. Subhas Madavu Salian, Mahuya Bagui, Raksh Vir Jasra, "Industrially relevant ethylene trimerization catalysts and processes" **Applied Petrochemical Research,** 2021, 1-13.
8. Rajendra Srivastava, Rajat Ghalta, Ashish Kumar Kar," Selective Production of Secondary Amine by the Photocatalytic Cascade Reaction Between Nitrobenzene and Benzyl alcohol over Nanostructured Bi2MoO6 and Pd NPs Decorated Bi2MoO6" **Chemistry–An Asian Journal,** 2021 https://doi.org/10.1002/asia.202100952
9. Abhinav Kumar, Rajendra Srivastava, "Rose-like Bi2WO6 Nanostructure for Visible-Light-Assisted Oxidation of Lignocellulose-Derived 5-Hydroxymethylfurfural and Vanillyl Alcohol" **ACS Applied Nano Materials,** 2021, 4, 9, 9080–909,

Upcoming Symposium/ Conferences/Seminars

1. 2022-4-22: ICCCSTNE 2022: International Conference on Carbon Capture, Storage Technologies, and Negative Emissions

2. 2022-1-28: ICCCTPM 2022: International Conference on Carbon Capture Technologies and Pollution Management
3. CHEMCON-2021, December 27-30, 2021, Bhubaneswar, India https://www.chemcon2021.com
4. XVth International Symposium on Environment, Catalysis and Process Engineering (ECGP-2021) November 23-25, 2021 Marrakech, Morocco. https://ecgpmorocco.com

Announcements

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

Name	Achievement
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 	**Professor Jai Krishna Memorial Award by Indian National Academy of Engineering (INAE)**
Dr. Raksh Vir Jasra, *FNA, FNAE* Senior Vice President & Head, Reliance Technology Group, Reliance Industries Ltd. Vadodara, India, & President, Catalysis Society of India 	**Lifetime Achievement Award 2021 by Indian Chemical Society**

Quote of the Month

"The future depends on what you do today." — Mahatma Gandhi

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