December 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 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.

Commercial & Policies

- **Chlor-Alkali, Ethylene Dichloride (EDC) and Polyvinyl Chloride (PVC) production facility in Ruwais through Strategic Joint Venture by Reliance and TA'ZIZ**

Abu Dhabi Chemicals Derivatives Company RSC Ltd. (TA'ZIZ) and Reliance Industries Limited (RIL) have agreed to launch 'TA'ZIZ EDC & PVC', a world-scale chemical production partnership at the TA'ZIZ Industrial Chemicals Zone in Ruwais (UAE). The new joint-venture will construct and operate a Chlor-Alkali, Ethylene Dichloride (EDC) and Polyvinyl Chloride (PVC) production facility, with an investment of more than $2 billion. Source: Reliance, 12/7/2021.

PVC applications in building and construction dominated the overall end-user industry share in terms of both volume and value in 2020. The accelerating usage of PVC in electric vehicles is projected to act as an opportunity for the market in the future------ CSI

- **GACL, CSIR-IICT Develop Indigenous Technology to Make Hydrazine Hydrate**

Based on the indigenous and environment-friendly technology developed by CSIR-IICT and GACL, GACL announced setting up of a commercial scale plant at its Dahej facility at an estimated cost of ₹405 crore to manufacture 10,000 tonnes per annum of Hydrazine Hydrate. Commissioning of this plant is expected by first quarter of 2022. Currently, India is importing Hydrazine Hydrate from Europe and other countries.
Source: https://www.thehindubusinessline.com/companies/gacl-iict-develop-indigenous-technology-to-make-hydrazine-hydrate/article37524612.ece

Step towards Atmanirbhar Bharat through indigenously developed technology ------ CSI

- **Reliance to Restructure and Repurpose Gasification Assets**

The Board of Reliance Industries Limited (RIL) has decided to implement a Scheme of Arrangement to transfer Gasification Undertaking into a Wholly Owned Subsidiary (WOS). The

Gasification project at Jamnagar (India) was set up with the objective to produce syngas to meet the energy requirements. As RIL progressively transitions to renewables as its primary source of energy, more syngas will become available for upgradation to high value chemicals including C1 chemicals and hydrogen. Source: Reliance Industries, 11/24/2021.

The repurposing of the gasification assets will free up syngas to transition into higher value-added chemicals to meet India's domestic demands as well as specialties for export, intermediates, and fertilizers. ------- CSI

- **CSIR-IIP's bio-jet Fuel Technology Receives Formal Military Certification**

CSIR-IIP technology to produce bio-jet fuel has been formally approved for use on military aircraft of the Indian Air Force (IAF). This certification represents India's growing confidence in aviation biofuel sector and another step towards 'Atmanirbhar Bharat'. The technology, developed by CSIR-IIP has undergone evaluation tests and trials over the last three years. Fuel being the lifeline of aircraft requires thorough analysis before being filled into manned flying machines.
Source: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1776193

This clearance will enable Indian armed forces to use bio-jet fuel produced using indigenous technology across all its operational aircraft. This will also enable early commercialization of the technology and its mass production------- CSI

- **Versalis to License Technology to Indian Company Supreme Petrochem Ltd for Production of Styrenic Polymers**

Versalis, Eni's chemical company, has agreed to license the continuous mass technology for a 70 KTY ABS unit to Supreme Petrochem Ltd. a leading Indian polystyrene (PS) and expandable polystyrene producer. The unit will be built in the Amdoshi –Wangani, District Raigad, in Maharashtra. This state-of-the-art technology will produce styrenic polymers with a low carbon footprint owing to reduced emissions and energy consumption. Source: Versalis, 12/3/2021.

- **IIT Madras to Launch Global Consortium Aimed at Low Carbon Future**

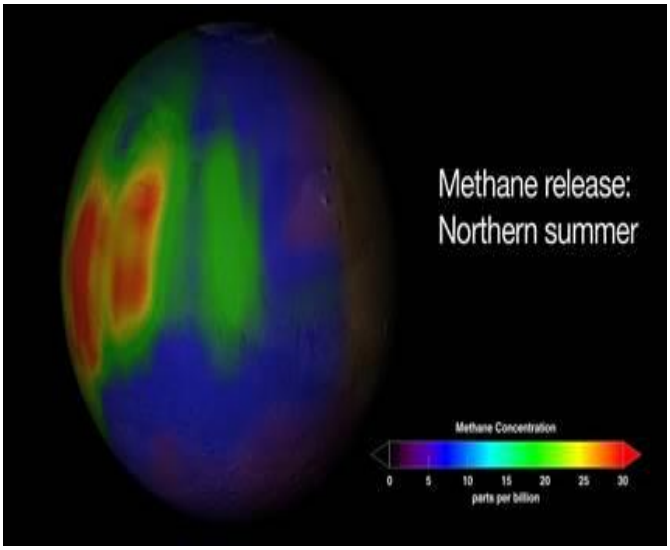
The Indian Institute of Technology Madras will launch Global Energy Consortium during IIT Madras Energy Summit to be held from December 14 to 16 to boost the transformation towards a low carbon future. The consortium will focus on research, development, and commercialization support on technologies across the entire value chain: energy sources, conversion technologies, integration, and storage. Over 50 global faculty with significant expertise and contributions through technologies and highly cited research publications will work in areas such as carbon capture and storage, gas hydrates and renewable energy systems. This includes applications in desalination and cold storage, electrolyser technologies for CO_2 conversion and beyond lithium energy storage technologies.
Source: The Hindu Business Online, 12/6/2021.

- **Sinopec Completes Successful Trial of Crude-to-Olefin Technology**

China's Sinopec Corp. says it has completed a successful trial processing crude oil directly into olefin, making the top Asian refiner one of the world's few companies that have applied the technology at an industrial scale. With a yield of close to 50%, the manufacturing process significantly cuts production cost as well as CO_2 emissions, compared with the traditional approach of refining crude into intermediate fuels which are further processed into olefin, Sinopec said. Following the trial at Sinopec subsidiary plant in Tianjin (China), the refiner will follow up with building a 1-MMtpy crude-to-olefin plant, it said. China is expected to cap its primary crude oil refining capacity at 1 B tons annually by 2025 (20 MMbpd), under a national goal to hit a carbon emission peak before 2030. However, it remains short of petrochemicals such as plastics and synthetic fibre. Source: Hydrocarbon Processing, 11/17/2021.

Scientific Updates

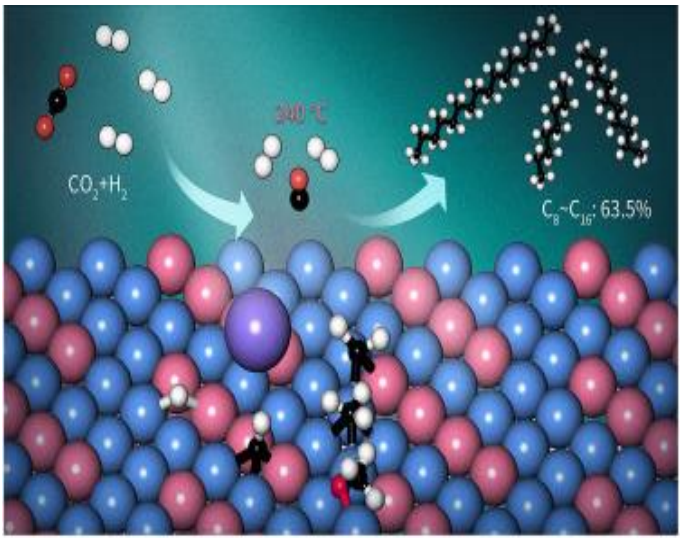
- **Catalyst Technology Converts Methane Greenhouse Gas into Useful, Valuable Chemicals**



Yue Wu and his research group at Iowa State University have tested a catalyst technology for conversion of methane to value added chemicals. The catalyst consists of one or two layers of platinum, each layer just an atom thick, deposited on two-dimensional metal carbide structures called "MXenes." In this case, the structures are made from carbon, molybdenum, and titanium. Keys to the methane to ethane/ethylene conversion are making the carbides pure enough and making the surfaces clean enough to support the reactions. The reactions exhibit about 7% methane conversion with about 95% selectivity toward ethane/ethylene in a continuously operating fixed-bed reactor. The Iowa State University Office of Innovation Commercialization is seeking a patent for the technology. Source: Phys.Org, 12/8/2021.

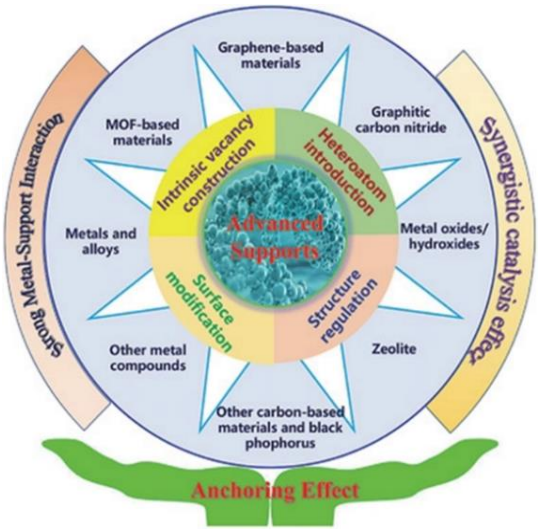
- **Direct Conversion of CO_2 to a Jet Fuel over CoFe Alloy Catalysts**

Na-modified CoFe alloy catalyst using layered double-hydroxide precursors is reported to directly transforms CO_2 to a jet fuel composed of C_8–C_{16} jet-fuel-range hydrocarbons with very high selectivity.



At a temperature of 240°C and pressure of 3 MPa, the catalyst achieves an unprecedentedly high C_8–C_{16} selectivity of 63.5% with 10.2% CO_2 conversion and a low combined selectivity of less than 22% toward undesired CO and CH_4. Spectroscopic and computational studies show that the promotion of the coupling reaction between the carbon species and inhibition of the undesired CO_2 methanation occur mainly due to the utilization of the CoFe alloy structure and addition of the Na promoter. This study provides a viable technique for the highly selective synthesis of eco-friendly and carbon-neutral jet fuel from CO_2. Source: The Innovation, 2(4)100170

- **Advanced Support Materials and Interactions for Atomically Dispersed Noble-Metal Catalysts: From Support Effects to Design Strategies**



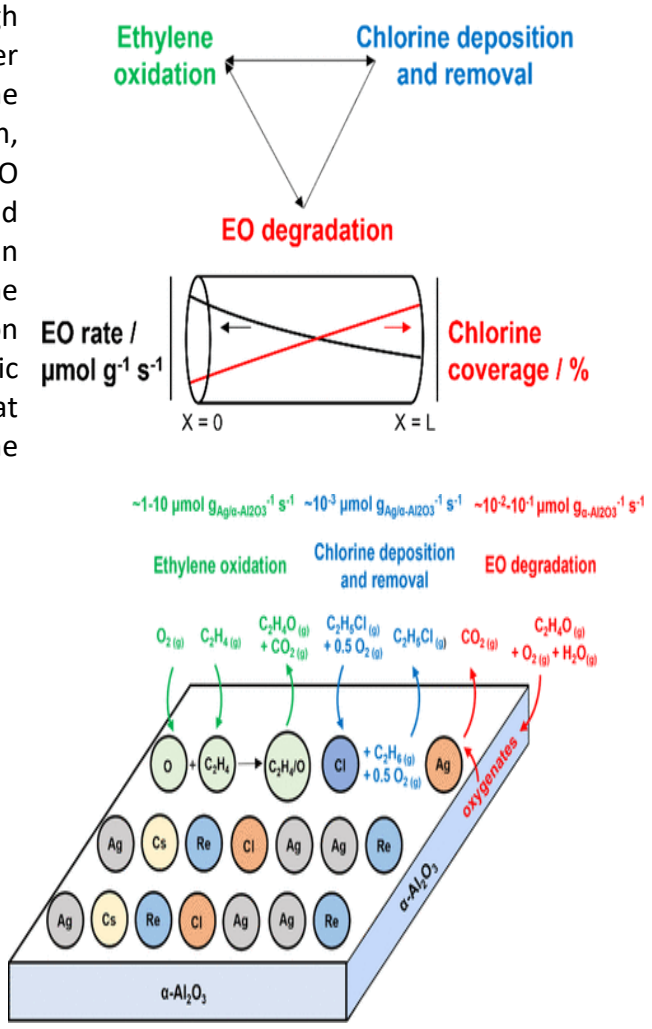
In this review, the support effects in noble-metal SACs are first systematically introduced, including anchoring effects, strong metal–support interactions, and synergistic catalysis effects. Moreover, the most recent advances in support materials are classified and discussed in detail with a focus on their anchoring mechanism. Importantly, design strategies for advanced supports are summarized for guiding the development and utilization of advanced support materials. Possible future research directions for support materials are also put forward to help overcome the current issues facing noble-metal SACs. Source: Advanced Energy Materials; https://doi.org/10.1002/aenm.202102556

- **Mechanocatalytic Room-Temperature Synthesis of Ammonia from Its Elements Down to Atmospheric Pressure**

Ferdi Schüth and colleagues, Max Planck Institute for Coal Research, Mülheim an der Ruhr, Germany, have produced ammonia using mechanocatalysis in ball mills at room temperature and down to atmospheric pressure. The team first performed a screening in a batch reactor:

Potential catalysts were loaded into a milling jar together with steel balls and then milled under a mixture of hydrogen and nitrogen. After each experiment, the gas phase was analyzed using infrared spectroscopy. The best catalyst, cesium-promoted iron, was then used in a continuously operating system under gas flow, leading to continuous ammonia formation with concentrations of more than 0.2 vol% at 20 bar and room temperature. Source: https://onlinelibrary.wiley.com/doi/full/10.1002/anie.202112095

- **Interdependencies Among Ethylene Oxidation and Chlorine Moderation Catalytic Cycles Over Promoted Ag/α-Al_2O_3 Catalysts**



Ethylene epoxidation transpires with high ethylene oxide (EO) selectivity (~90%) over promoted Ag/α-Al_2O_3 catalysts via the concurrent propagation of ethylene oxidation, chlorine deposition and removal, and EO degradation catalytic cycles with reactant and product species (C_2H_4, O_2, CO_2) involved in multiple reaction pathways. The interdependent kinetics of ethylene oxidation and chlorine deposition and removal catalytic cycles by measuring EO synthesis rates at constant chlorine coverages is resolved. The systematic variation in ethylene and oxygen reaction orders for ethylene epoxidation with chlorine coverage illustrates how organochloride promoters impact the kinetics of EO synthesis. EO degradation kinetics measured over promoted α-Al_2O_3 materials are not influenced by the chlorine promoter; however, EO degradation rates over α-Al_2O_3 can be as high as 3% of total EO formation rates and can contribute perceptibly to lowering net EO selectivity. A reactor model developed that incorporates the kinetic interdependencies among the three catalytic sequences in terms of discernible changes in reaction orders for EO formation, chlorine coverage, and EO degradation rates across a packed bed and such a description, in turn, enables accurate predictions of the EO rate and selectivity over a wide range of process conditions. Source: ACS Catal. 2021, 11, XXX, 14864–14876 https://doi.org/10.1021/acscatal.1c03493

Catalysis Research out of India

1. K.K. Parmar, G. Padmavathi, Sumeet Kumar Sharma, Rakshvir Jasra "Effect of sulfur additives on coke formation during steam cracking of naphtha" **Journal of Chemical Sciences,** 2021, 133(4), 1-9.
2. Niteen B. Patil, Ranjit S. Atapalkar, Subhash P. Chavan, Amol A. Kulkarni, "Multi-Step Synthesis of Miltefosine: Integration of Flow Chemistry with Continuous Mechanochemistry" **Chemistry–A European Journal,** 2021, https://doi.org/10.1002/chem.202103499
3. Naresh Nalajala, Kranti N Salgaonkar, Inderjeet Chauhan, Siva Prasad Mekala, Chinnakonda S Gopinath, "Aqueous Methanol to Formaldehyde and Hydrogen on Pd/TiO2 by Photocatalysis in Direct Sunlight: Structure Dependent Activity of Nano-Pd and Atomic Pt-Coated Counterparts" **ACS Appl. Energy Mater.** 2021, 4, 11, 13347–13360.
4. Abhijeet H Thaker, Vivek V. Ranade, "Towards harnessing hydrodynamic cavitation for producing emulsions: Breakage of an oil drop in a vortex-based cavitation device" **Chemical Engineering and Processing -Process Intensification,** 2021, https://www.sciencedirect.com/science/article/pii/S0255270121004372
5. Sanjay Nagarajan, Vivek V Ranade, "Valorizing Waste Biomass via Hydrodynamic Cavitation and Anaerobic Digestion" **Industrial & Engineering Chemistry Research,** 2021, 2021, 60, 46, 16577–16598.
6. Abhijeet H Thaker, Vivek V Ranade Drop, "breakage in a single-pass through vortex-based cavitation device: Experiments and modeling" **AIChE Journal** 2021 https://doi.org/10.1002/aic.17512
7. Priya P Patel, Dhara H Morawala, Aayushi Lodhi, Hemant S Parmar, Kalpana C Maheria, "H-ZSM-5 Catalysed Esterification of Levulinic Acid to Synthesize N-Pentyl Levulinate" **Catalysis in Green Chemistry and Engineering**, 2021, 4(2),23-33.
8. Henilkumar M Lankapati, Piyush M Dankhara, Dharmesh R Lathiya, Brijesh Shah, Uma V Chudasama, Lalita Choudhary, Kalpana C Maheria, "Removal of lanthanum, cerium and thorium metal ions from aqueous solution using ZrT hybrid ion exchanger" **Sustainable Energy Technologies and Assessments,** 2021, 47, 101415.

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. The 58th Annual Convention of Chemists 2021, the yearly event of the Indian Chemical Society (http://indianchemicalsociety.com/) is being organized from 21–24, December 2021.
5. January 07-08, 2022-ICREA 2022-International Conference on Renewable Energy Applications, Singapore
6. December 20-21, 2021-ICIMCC 2021- International Conference on Inorganic Materials Chemistry and Catalysis, Istanbul, Turkey

Announcements

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

Name	Achievement
Prof. Manoj B. Gawande Associate Professor Department of Industrial and Engineering Chemistry, Institute of Chemical Technology, Mumbai – Marathwada Campus, Jalna 	Elected as Fellow of Indian Chemical Society (ICS) August 2021

Quote of the Month

"A man is but the product of his thoughts. What he thinks, he becomes."
— Mahatma Gandhi

Disclaimer: The information presented in this newsletter is published in open domain.