January 15, 2022

CSI Communication

Monthly Newsletter of Catalysis Society of India

Circulated to all CSI Members

Important Announcement:

Wishing all Catalysis Society of India Members Very Happy, Healthy and Prosperous New Year!!!

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

- **BASF Establishes Standalone Business Entity Focused on Mobile-Emissions Catalysts**

BASF announced that it will establish a separate mobile-emissions catalysts, automotive catalysts recycling and associated precious metal services entity. The new entity will be named BASF Automotive Catalysts and Recycling. The new standalone structure will prepare the business for the upcoming changes in the internal combustion engine market and allow for future strategic options. The new entity will continue to operate globally and comprise approximately 20 production sites and will start in January 2022. Additionally, BASF will further increase its focus on its e-mobility offerings. Through this strategic focus on battery materials and the new set-up for the mobile emissions catalysts business, BASF will continue to offer automotive industry customers sustainable and innovative solutions. Source: Chemical Engineering, December 8, 2021.

- **BPCL, BARC Collaborate to Scale up Technology for Green Hydrogen Production**

Bharat Petroleum Corporation (BPCL) has collaborated with Bhabha Atomic Research Centre (BARC) to scale up Alkaline Electrolyser technology for Green Hydrogen production. Through collaboration, BPCL intend to scale up Indigenous Alkaline Electrolyser Technology and look forward to commercializing it for large use especially in Refineries.
Source: https://www.business-standard.com/article/companies/bpcl-barc-collaborate-to-scale-up-tech-for-green-hydrogen-production-121121301008_1.html

Step towards Atmanirbhar Bharat through indigenously developed Alkaline Electrolyser ------ CSI

- **NTPC Awards India's First Green Hydrogen Microgrid Project**

India's largest integrated energy company has awarded project of 'Standalone Fuel-Cell based Micro-grid with hydrogen production using electrolyser' at NTPC Simhadri (A.P.). This will be India's first Green Hydrogen based Energy Storage Project and one of world's largest. It would be a precursor to large scale hydrogen energy storage projects and would be useful for studying and deploying multiple microgrids in various off-grid and strategic locations of the country. The hydrogen would be produced using the advanced 240 kW Solid Oxide Electrolyser by taking input power from the nearby Floating Solar project. The hydrogen produced during sunshine hours would be stored at high pressure and would be electrified using a 50 kW Solid Oxide Fuel Cell. https://www.ntpc.co.in/en/media/press-releases/details/ntpc-awards-india%E2%80%99s-first-green-hydrogen-microgrid-project

- **IIT Guwahati Team Develops Efficient Perovskite Solar Cells to Produce Electricity from Sunlight**

Indian Institute of Technology, IIT Guwahati researchers, have developed a cost-effective perovskite solar cell to produce electricity from sunlight. The perovskite-based semiconducting devices are considered the most promising due to their low-cost, ease of manufacturing as roll-to-roll devices, high material availability and easy recyclability. The devices developed can achieve power conversion efficiency as much as 21%. This efficient device was developed utilizing economical solution-based photovoltaic device processing techniques at mild room temperature and realizing high ambient, thermal, and optical stability.

Source: https://economictimes.indiatimes.com/industry/renewables/iit-guwahati-team-develops-efficient-perovskite-solar-cells-to-produce-electricity-from sunlight/articleshow/88429557.cms

- **Indian Oil Corporation Chooses Nuberg EPC to Develop Bio-Ethanol Plant Project**

Nuberg EPC has been awarded a contract to develop a 10 tons per day (TPD) bio-ethanol project to deliver 2nd generation bioethanol on a Lump Sum Turnkey (LSTK) basis in Panipat, Haryana (India). The project, owned by Indian Oil Corporation (IOCL), will produce ethanol for fuel blending. Nuberg EPC will be the single-point solution company responsible from concept to commissioning of the project. The 10 TPD Bio-Ethanol project is based on the technology developed by IOCL's R&D team. Source: Process Worldwide, 12/14/2021

One striking advantage of ethanol over other fuel sources is that it does not cause pollution to the environment. ---- CSI

- **Toyo Awarded Refinery Plant Project in India**

Toyo Engineering India Private Limited (Toyo-India), a wholly owned subsidiary of Toyo Engineering Corporation (Toyo-Japan), has been awarded a contract by Numaligarh Refinery Limited (NRL) for the Engineering, Procurement, Construction and Commissioning (EPCC) of a 3.55 MMTPA Diesel Hydro-treating (DHT) Unit in Assam state of India. NRL is undertaking a major expansion project from 3 MMTPA to 9 MMTPA consisting of several process units with total

project cost of Rs. 28,026 Crore, which is part of the Government's Hydrocarbon vision 2030 for the economic growth to meet the deficit of petroleum products in North East India. This DHT will produce diesel confirming to BS VI specifications by hydrotreating a blend of refinery products. Source: Toyo, 12/9/2021.

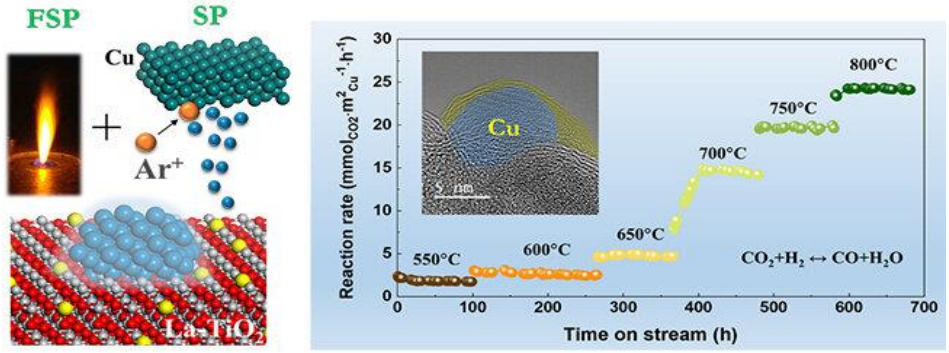
- **Sulzer's Technology Converting Bamboo into Bioethanol in Pioneering Indian Bio-refinery**

India's first bio-refinery, Assam Bio Refinery Pvt Ltd., built by Chempolis technology, is a groundbreaking joint venture that will be the only refinery in the world to create bioethanol from bamboo. Assam Bio Refinery is a joint venture formed between the state-run oil refining company, Numaligarh Refinery Ltd. and two Finnish companies, Fortum and Chempolis. The facility will use Sulzer's unrivalled experience in pump design and manufacturing as well as separation technology to ensure long-term reliability and efficiency in the refining processes. Once complete, the bio-refinery will use 300,000 tons of bamboo each year. Source: Sulzer, 12/16/2021.

Scientific Updates

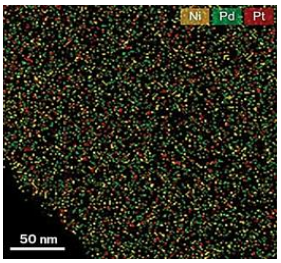
- **Scientists Create Ultra-Stable Cu-based Catalysts**

Two unique technologies, magnetron sputtering (SP) and flame spray pyrolysis (FSP), are combined to reconstruct the electronic structure of metallic Cu and the reducibility of the TiO_2 support, respectively. Classic strong metal-support interactions (SMSI) on non-noble metal Cu-based catalyst at mild reduction temperatures is created for the first time and realized controllable preparation of ultra-highly stable Cu-based catalyst. This catalyst exhibited ultra-stable performance for more than 500 hours at 600 degrees Celsius. The sintering of Cu nanoparticles was effectively suppressed even at 800 degrees Celsius. Moreover, the strength of SMSI could be effectively controlled not only by reducing temperatures as before but also by tailor-made Cu via sputtering power regulation or decorated supports for rational catalyst design on demands. Source: Phys.Org, 12/14/2021.



Cu/LaTiO$_2$ heterogeneous catalyst at 800 degrees Celsius. Credit: Yu Jiafen

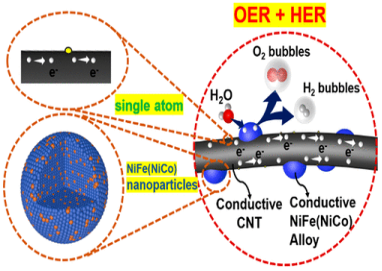
- **Single-Atom Catalysts Reach Record-breaking Density**



In single-atom catalysts, individual metallic atoms are dispersed on a solid support, with each atom available to catalyze a reaction. At high catalyst loadings, however, it is hard to keep the atoms isolated and prevent metallic clusters from forming. Most single-atom catalysts average between 1% and 2% loading measure of catalyst concentration on the support. This approach enables single-atom catalysts with up to 23% metal content by weight. It works with most first-row transition metals, as well as with noble metals like ruthenium, iridium, and platinum, all of which have extensive applications in heterogeneous catalysis. The new catalysts were produced by introducing a two-step annealing process, which tunes the material's properties via heat treatment. In the first step, a low-temperature treatment allows metals bound to ligands to anchor on the support surface in a controlled way and thus prevents metal clusters from forming. A subsequent, higher-temperature step removes the ligands, leaving just the metals. Source: Chemical & Engineering News, 1/2/2022.

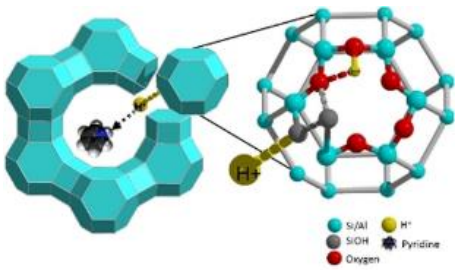
- **Single-Atom and Bimetallic Nanoalloy Supported on Nanotubes as a Bifunctional Electrocatalyst for Ultrahigh-Current-Density Overall Water Splitting**

Non-noble-metal bifunctional catalysts with single Ni atoms, single Fe atoms, and NiFe nanoalloys supported on carbon nanotubes (NiSAFeSA-NixFe/CNT) are rationally designed and fabricated. Moreover, the catalyst enables the overall water splitting at a low cell voltage of 1.49 V to achieve 10 mA cm^{-2} in 1 M KOH. At a cell voltage of 1.80 V, the current density is as high as 382 mA cm^{-2}, which surpasses those of most materials reported so far. After a simple two-step oxidation and rereduction procedure, the catalytic performances of the OER, HER, and overall water splitting recover completely to their original levels. This work not only provides a potential catalyst candidate for economically realizing water splitting but also shows a method for reactivatable catalyst design. Source: ACS Catalysis 2022 https://pubs.acs.org/doi/abs/10.1021/acscatal.1c04454



- **Unlocking the Potential of Hidden Sites in Faujasite: New Insights in a Proton Transfer Mechanism**

By combining advanced spectroscopies (IR and solid-state NMR) and molecular modeling, this work reveals the presence of a proton transfer from the sodalite cage to the supercage of USY zeolite. When a basic probe molecule is in proximity, the protonation is first assured by a "gate-keeper" silanol, which is restored by a proton transfer from the Brønsted acid site located deeper in the sodalite cage.

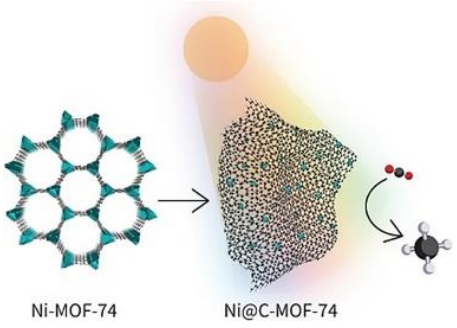


Zeolite Y and its ultra-stabilized hierarchical derivative (USY) are the most widely used zeolite-based heterogeneous catalysts in oil refining, petrochemistry, and other chemicals manufacturing. The present study highlights the key difference leading to the exceptional catalytic performance of USY versus the parent zeolite Y. The results highlight a hitherto unreported proton transfer involving inaccessible active sites in sodalite cages that contributes to the exceptional catalytic performance of USY

Source: https://doi.org/10.1002/anie.202110107

- **An Efficient Metal–Organic Framework-Derived Nickel Catalyst for the Light Driven Methanation of CO2**

The synthesis of a highly active and stable metal-organic framework derived Ni-based catalyst for the photothermal reduction of CO_2 to CH_4 is reported. Through the controlled pyrolysis of MOF-74 (Ni), the nature of the carbonaceous species and therefore photothermal performance can be tuned. CH4 production rates of 488 mmol g^{-1} h^{-1} under UV-visible-IR irradiation are achieved when the catalyst is prepared under optimized conditions. No particle aggregation or significant loss of activity were observed after ten consecutive reaction cycles or more than 12 hours under continuous flow configuration. Finally, as a proof-of-concept, we performed an outdoor experiment under ambient solar irradiation, demonstrating the potential of our catalyst to reduce CO_2 to CH_4 using only solar energy. Source: https://doi.org/10.1002/anie.202111854



Catalysis Research out of India

1. Sunesh S. Mani, Sivaraj Rajendran, Naresh Nalajala, Thomas Mathew, Chinnakonda S. Gopinath, "Electronically Integrated Mesoporous Ag–TiO_2 Nanocomposite Thin films for Efficient Solar Hydrogen Production in Direct Sunlight, **Energy Technology** 10(1) 2022, 2100356.
2. Nikhil H Margi, Ganapati D Yadav, "Pseudoionone synthesis from citral and acetone in a fixed bed catalytic reactor with lanthanum modified calcium oxide" **New Journal of Chemistry 2022** https://pubs.rsc.org/en/Content/ArticleLanding/2022/NJ/D1NJ02626G
3. Mohd Jubair Aalam, Deepa, Pooja Chaudhary, Dhan Raj Meena, Geeta Devi Yadav, Surendra Singh, "DABCO-based chiral ionic liquids as recoverable and reusable organocatalyst for asymmetric Diels–Alder reaction" **Chirality**, 2022, 34, Pages: 134-146
4. Niraj S. Topare, Satish V. Khedkar, Kiran D. Patil, Nilesh Inamdar, "Design, Fabrication of Multi-Functional Reactor System and Its Application for Biodiesel Production" **American**

Institute of Physics Conference Proceedings,2417*(1):030002-1-030002-8, DOI: 10.1063/5.0072737,*

5. Niraj S. Topare, Kiran D. Patil, Satish V. Khedkar, Nilesh Inamdar, "Lab Scale Batch Reactor Design, Fabrication and Its Application for Biodiesel Production", *Book Chapter*, Springer *International Publishing*, *Available Online, December 2021* DOI: 10.1007/978-3-030-69925-3_78.
6. P.A. Kamble, ML Kantam, V.K. Rathod, "Hydrogenation of Furfural to Furfuryl Alcohol over Nickel Supported Bentonite Catalyst" **ChemistrySelect ,** 2021, 6 (25), 6601-6606.
7. Muzammil Y Khan, Sunil S. Joshi, Vivek V Ranade, "Hydrogen solubility in biphasic liquid reaction mixture of cinnamaldehyde hydrogenation: experimental and mathematical modeling study", **Journal of Chemical Sciences,** 2022, 134 (1) 1-10.

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Upcoming Symposium/ Conferences/Seminars

1. International Conference on Biocatalysis & Green Chemistry Online 04-05 April 2022 https://crgconferences.com/green-chemistry/
2. International Conference on Environmental Materials and Catalysis (CEMC 2022) 22-24 April, 2022, Suzhou, China.
3. 2022-4-22: ICCCSTNE 2022: International Conference on Carbon Capture, Storage Technologies, and Negative Emissions.
4. Alternate Energy Materials-2022, 6-8 April 2022, Imperial College London, England. https://www.aemlondon.com/
5. 12th BENGALURU INDIA NANO 2022, Virtual 7th - 8th March 2022.
6. 2nd Global Summit and Expo on Nanotechnology and Nanomaterials (GSENN2022) Copenhagen, Denmark on June 13-15, 2022. https://www.thescientistt.com/nanotechnology-nanomaterials/2022/speakers.php
7. International Conference on Green, Sustainable & Analytical Chemistry, 07-08 June 2022 Goa, India
8. World Congress on Green Chemistry and Green Engineering (WCGCGE) 26th February 2022, Pune, India
9. International Conference on Electrochemistry (ICE), 10th April 2022 Nagpur, India

Announcements

Tribute

CSI pays a tribute to Professor Robert Howard Grubbs, California Institute of Technology (Caltech), Pasadena, USA, and ***2005 Nobel Laureate*** in Chemistry, who passed away on December 19, 2021. Professor Grubbs was well-known for his work on olefin metathesis awarded. The Nobel Prize in Chemistry 2005 jointly to Yves Chauvin, Robert H. Grubbs, and Richard R. Schrock "for the development of the metathesis method in organic synthesis."

Grubbs had developed the eponymous Grubbs catalysts, a series of ruthenium carbene complexes that can promote olefin metathesis. These catalysts are widely used in synthetic organic chemistry. In 1998, Grubbs co-founded the startup Materia with Mike Giardello in Pasadena, CA, USA, to make them commercially available.

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

Name	Achievements
Dr. Kiran Patil Professor of Chemical Engineering, School of Chemical Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune, Maharashtra, India 	▪ Elected as Fellow of Indian Chemical Society (ICS) December 2021 ▪ Nominated as Margadarshak by AICTE-NBA, New Delhi for Mentoring Higher Educational Institutes to enhance the quality of education. ▪ Selected as a Team Member, National Assessment and Accreditation Council (NAAC), Bangalore
Dr. Sharad Lande Assistant Vice-President (R&D), Reliance Industries Ltd. Mumbai, India 	Performance Excellence Award in Leadership 2021 by Life Way Tech India
Professor Anjali Patel Department of Chemistry, The Maharaj Sayajirao University of Baroda, Vadodara, Gujarat 	Elected as Fellow of Indian Chemical Society (ICS) December 2021

Editorial Team

Dr. Sharad Lande

Dr. Raksh Vir Jasra

Quote of the Month

"See for the highest, aim at the highest, and you shall reach the highest." — **Swami Vivekananda**

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