

**Monthly Newsletter of Catalysis Society of India**  
**Circulated to all CSI Members**

There has been continued quest for mobility by humankind. After Second World War, automobile and air aviation emerged as major mode of transportation. Catalysis has been central to this mobility through its contribution in Transportation Fuel, Materials & Pollution Abatement and Elastomers for Tires. It is catalytic technical contributions from catalysis that has facilitated running of nearly 1.2 billion vehicles today on the Globe and providing mobility and connectivity to humankind.



With the world going through major energy shift from fossil fuels to renewables, catalysis is again going to play a central role in providing alternative energy technologies like Fuels Cell and Hydrogen as economical and safe energy source for transportation.

- **IOC to invite bids for 15 PEM Fuel Cell Buses**

Indian Oil Corporation (IOC), the country's largest refiner and fuel retailer is reported to be inviting bids to procure 15 Polymer Electrolyte Membrane (PEM) fuel cell buses. This project is the first ever attempt to address all the aspects of hydrogen-based mobility as the ultimate green option.

**Source:** <https://www.thehindubusinessline.com/companies/indianoil-to-invite-bids-for-15-pem-fuel-cell-buses/article33401936.ece>

- **LTHE Wins Largest EPCC Contract in Indian History**

Larsen & Toubro's wholly owned subsidiary, L&T Hydrocarbon Engineering (LTHE), has won an order from HPCL Rajasthan Refinery, a joint venture between Hindustan Petroleum Corporation and the Government of Rajasthan reportedly the biggest EPCC contract awarded in the country to date in the Refinery and Petrochemical sector. The Dual Feed Cracker Unit (DFCU) will be used

to convert refinery naphtha and off gases to produce polymer grade ethylene and propylene via the process of thermal cracking. The ethylene and propylene will be used as feedstock for downstream polyethylene and polypropylene units. **Source:** [https://www.business-standard.com/article/companies/l-t-arm-wins-large-engineering-order-from-hindustan-petroleum-jv-121010401111\\_1.html](https://www.business-standard.com/article/companies/l-t-arm-wins-large-engineering-order-from-hindustan-petroleum-jv-121010401111_1.html) 1/4/2021.

#### ▪ **Draft 5<sup>th</sup> National Science, Technology, & Innovation Policy for public consultation**

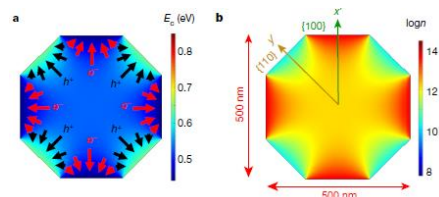
A new Science, Technology, and Innovation Policy (STIP) has been initiated by government of India to march ahead on a sustainable development for achieving an **“Atmanirbhar Bharat”**. The new Science, Technology, and Innovation Policy aims to bring about profound changes through short-term, medium-term, and long-term mission mode projects by building a nurtured ecosystem that promotes research and innovation on the part of both individuals and organizations.

The new policy, STIP, revolves around the core principles of being decentralized, evidence-informed, bottom-up, experts-driven, and inclusive. Also, it aims to bring in the concept of dynamic policy with a robust policy governance mechanism incorporating features such as implementation strategy, periodic review, policy evaluation, feedback, and adaptation, and most importantly, a timely exit strategy for various policy instruments. STIP policy document Ver 1.4 is finalized and available ([https://dst.gov.in/sites/default/files/STIP\\_Doc\\_1.4\\_Dec2020.pdf](https://dst.gov.in/sites/default/files/STIP_Doc_1.4_Dec2020.pdf)) for further suggestions, inputs and comments on the draft latest by **Monday the 25th January, 2021** on email: [india-stip@gov.in](mailto:india-stip@gov.in)

## Scientific

#### ▪ **Photocatalytic Water Splitting with a Quantum Efficiency of almost unity**

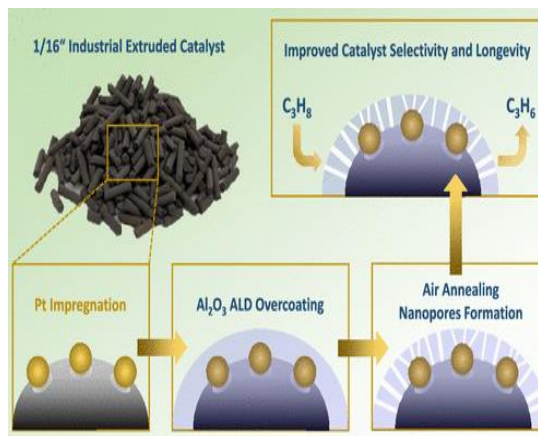
Using a modified aluminium-doped strontium titanate ( $\text{SrTiO}_3:\text{Al}$ ) photocatalyst, overall water splitting at an external quantum efficiency of up to 96% at wavelengths between 350 and 360 nm, equivalent to an internal quantum efficiency of almost unity is demonstrated. By selectively photodepositing the co-catalysts  $\text{Rh}/\text{Cr}_2\text{O}_3$  and  $\text{CoOOH}$  on different crystal facets of the semiconductor particles using anisotropic charge transport, the hydrogen and oxygen evolution reactions could be promoted separately. This work demonstrates the feasibility of overall water splitting free from charge recombination losses and introduces an ideal cocatalyst/ photocatalyst structure for efficient water splitting. Catalyst designing is central to obtain consecutive charge transfers with minimum charge recombination to reach the upper limit of quantum efficiency.



Extending reported catalyst design in developing visible range semiconductors like,  $\text{Ta}_3\text{N}_5$  and  $\text{Y}_2\text{Ti}_2\text{O}_5\text{S}_2$  reported to split water, can lead to external quantum efficiency for these catalysts also be significantly increased. In that sense, this work provides a novel and potential approach for the development semiconductor photocatalysts for practical solar hydrogen production from water. **Source** : Tsuyoshi Takata et al. in Nature, Vol 581, 28 May 2020, 411 (<https://doi.org/10.1038/s41586-020-2278-9>)

### ▪ Atomic Layer Deposition (ALD) Improves Catalyst Selectivity and Life in Propane Dehydrogenation (PDH)

Propylene, a precursor for commodity chemicals and plastics, is being increasingly produced by PDH. The authors investigated the interplay of Pt loading, ALD overcoat thickness, and  $\text{Al}_2\text{O}_3$  support surface area on PDH activity, selectivity, and catalyst stability to show that applying a 6–8 Å thick layer of  $\text{Al}_2\text{O}_3$  on low-surface area  $\text{Al}_2\text{O}_3$  supports of  $\sim 90 \text{ m}^2/\text{g}$  surface area yields the optimal combination of stability and activity, while increasing propylene selectivity from 91 to 96%. Increased stability upon steaming deactivation occurs because the  $\text{Al}_2\text{O}_3$  overcoat prevents the Pt nanoparticles from sintering.

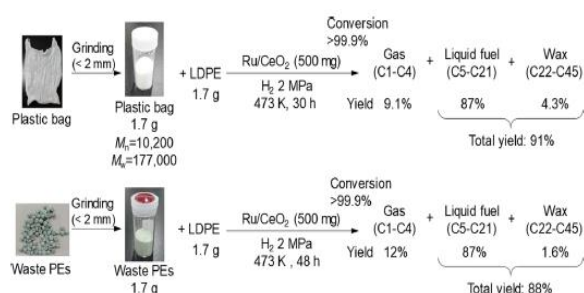


The authors speculated that the ALD overcoat selectively binds to the undercoordinated sites on the Pt nanoparticles, while leaving the more selective terrace sites available for dehydrogenation.

**Source:** <https://pubs.acs.org/doi/10.1021/acscatal.0c03391>

### ▪ Catalyst Transforms Plastic Waste into Valuable Ingredients at Low Temperature

Low-temperature catalytic upgrading of waste polyolefinic plastics to valuable chemicals such as liquid fuels and waxes by a heterogeneous catalyst is reported.  $\text{CeO}_2$ -supported Ru ( $\text{Ru}/\text{CeO}_2$ ) act as an effective and reusable heterogeneous catalyst, showing much higher activity than other metal-supported catalysts in hydrogenolysis of low-density polyethylene, and the catalyst worked even under mild reaction conditions such as low temperature of 473 K and low  $\text{H}_2$  pressure of 2 MPa, providing liquid fuel (C5-C21) and wax (C22-C45) in 77 % and 15 % yields (total 92 % yield), respectively.



This catalyst was applicable to hydrogenolysis of various low-density polyethylenes, high-density polyethylene, polypropylene to provide the valuable chemicals (liquid fuel + wax) in high yields (83–90 %). Furthermore, a commercial plastic bag and waste polyethylenes could be transformed to the valuable chemicals in high yields (91 % and 88 % yields). **Source:** Applied Catalysis B: Environmental, 2021; 285: 119805 DOI: 10.1016/j.apcatb.2020.119805

## Announcements and Recognition of CSI Members

- Catalysis Society of India (CSI)-Delhi Chapter organized National Webinar on “Emerging Energy Scenario: Catalysis Challenges” on 9<sup>th</sup> January 2021.
- Catalysis Research Scholars Meet (**CATSCHOL-2020**) organized by Catalysis Society of India, Mumbai Chapter & ICT, Mumbai on 19 & 20<sup>th</sup> December 2020.
- CSI Congratulates the following CSI members on the recognition they have received recently.

| Name                                                                                                                                                                                                                                                                           |                                                                                      | Achievement                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Prof. K. K. Pant</b> , PhD, FNAE, FNAS, FRSC, FIE(I), FIChE<br>Petrotech Chair Professor, Head, Department of Chemical Engineering, Indian Institute of Technology, New Delhi-110016                                                                                        |    | Elected as a Fellow National Academy of Sciences India (NASI) November 2020    |
| <b>Prof. Vivek Polshettiwar</b><br>Associate Professor 'G'<br>Department of Chemical Sciences, Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Mumbai 400005, INDIA                                                                                          |   | Elected as a Fellow National Academy of Sciences, India (NASI) November 2020  |
| <b>Dr. Raksh Vir Jasra</b> , FNA, FNAE<br>Senior Vice President & Head, Reliance Technology Group, Reliance Industries Ltd. Vadodara, India, & President, Catalysis Society of India & Honorary Faculty at Centre for Nanotechnology, Indian Institute of Technology, Guwahati |  | Elected as Fellow of Indian Chemical Society (ICS) December 2020             |
| <b>Prof. Kalpana C. Maheria</b><br>Associate Professor<br>Department of Chemistry<br>Sardar Vallabhbhai National Institute of Technology, Surat- 395 007, Gujrat, INDIA                                                                                                        |  | Elected as Fellow of Indian Chemical Society (ICS) December 2020             |

## Quote of the Month

**"We are what our thoughts have made us; so, take care about what you think. Words are secondary. Thoughts live; they travel far."** Swami Vivekanand

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

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/>