Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally Mandal, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Engineering atomically thin layers for enhanced hydrogen evolution reaction

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Hydrogen energy, with its high gravimetric energy density (142 MJ kg^{-1}) and cleanliness while producing by water electrolysis using renewable energy resources, is a promising alternative to fossil fuels with negligible carbon footprint. But the cathodic reaction of water electrolysis, Hydrogen Evolution Reaction (HER), is still limited only to noble metal like Pt based catalysts, which is costly and limited. In this study, we propose different strategies of addressing this by methods such as proposing ultra-low loaded noble-metal and non-noble-metal catalysts for efficient HER and fluorinated carbon (FC) based selective proton transport membranes for tuning the ions transport and confining the protons within the catalyst to enhance the HER activity. We have shown how strategically designed ultra-stable hBN_Au_Pt catalyst, with very low amount of Pt shows high intrinsic activity, while MoS_2 nanowalls catalyst helps overcome basal plane inactivity of transition metal dichalcogenide (TMD) catalysts by exposing abundant grain boundaries. Janus TMD structures exhibited enhanced activity through intrinsic dipole moments, with solvent dependent sono-activation further boosting their performance, especially in simple solvents like water. Finally, FC membranes demonstrated exceptional proton selectivity, high conductivity (~1000 mS cm^{-1}), and efficient blocking of gases and ions, enabling stable HER even under carbon monoxide poisoning and seawater conditions. Together, these systems highlight effective strategies to reduce reliance on noble metals while maintaining high catalytic efficiency.

Wednesday, Oct 28th 2026

11:30 Hrs (Tea / Coffee 11:15 Hrs)

Auditorium, TIFRH