RENEWABLE ENERGY SEMINAR

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INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

CoRE
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PHOTOCHEMICAL AND THERMOCHEMICAL METHODS
for green hydrogen generation

Prof. Ranga Rao earned his M.Sc. Chemistry from IIT Bombay, and PhD from Indian Institute of Science, Bangalore. He further worked as a postdoctoral researcher at the University of Trieste (Italy), National Institute of Materials and Chemicals Research (Tsukuba, Japan), and Institut de Recherches sur la Catalyse-CNRS (Villeurbanne, France). He visited Institut für Physikalische und Theoretische Chemie, Universität Erlangen-Nürnberg (Germany) and University of Augsburg (Germany). He also worked as visiting scientist for a year at the Institute for Molecular Science (Okazaki, Japan). He has been a faculty member at the Department of Chemistry, IIT Madras since 1996. His research interests include materials chemistry, heterogeneous catalysis, photocatalysis, energy conversion and storage, solid state electrochemistry and green hydrogen generation under ambient and thermochemical conditions.

He has published over 190 refereed journal articles including reviews in the above areas. He established the Solar Fuels Laboratory as part of DST-Solar Energy Harnessing Center in IIT Madras. He taught at IIT Hyderabad and IIT Tirupati, both Institutes mentored by IITM and also served as an Member of the Academic Council of IIT Palakkad and IIT Tirupati (2015-2017) and the Senate of IIT Tirupati (2019-2022).

His research work can be viewed at:
https://scholar.google.co.in/citations?user=tHlEUtoAAAAJ&hl=en

Hydrogen is an emerging renewable energy carrier to reduce the massive utilization of fossil fuels and associated environmental problems. Clean and green hydrogen can be generated by water splitting. Thermochemical, photochemical, photo-electrochemical, and PV electrolysis are some of the approaches actively pursued for generating green hydrogen.

Polymeric graphitic carbon nitride (g-C_3N_4) with band gap of ~2.7 eV is a stable non-toxic photoactive material to harvest solar photons from UV to visible range. The band gap of g-C_3N_4 is tunable by doping benzene and pyrimidine rings to extend the π-conjugation and which results in increased water splitting activity without using sacrificial agents. Nitrogen-rich g-$C_{3-x}N_{4+x}$ derivatives synthesized by solid–gas interface method also show higher photocatalytic water splitting ability.

Water can be split to produce hydrogen by thermochemical solid-steam reactions at high temperatures (~1000 $^{\circ}$C). Oxygen is extracted from H_2O by oxygen vacancies created by the pre-reduction of ceramic materials to produce green hydrogen. Thermochemical production of green hydrogen using ferrous scrap materials has been demonstrated using home-built thermochemical reactor. The learnings in pursuing this research will be shared in this talk.