Designing and Fabricating Nonprecious Nanomaterials and their Composites as Sustainable Catalysts for Fuel Cells and Water Splitting

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Abstract

The lack of sustainable and efficient catalysts for many renewable energy applications (*e.g.*, fuel cells and water splitting) and the unabated negative environmental impacts of fossil fuels remain among the most pressing issues facing the world today. In this talk, my research group's recent efforts on the synthesis of heteroatom-doped, metal-free or noble metal-free carbon nanostructured and nanoporous materials and their composites that exhibit high catalytic and catalytic activities for reactions such as the oxygen reduction reaction (ORR), the hydrogen evolution reaction (HER), the oxygen evolution reaction (OER), and the hydrazine oxidation reaction (HOR)—reactions that are relevant to fuel cells and water splitting, or renewable energy in general—will be discussed. Particular focus will be given to the various novel design and "nanostructuring" as well as heteroatom doping synthetic approaches employed in my group to make a series of nanostructured and nanoporous carbon and their composite catalysts. Moreover, fundamental and theoretical studies that helped us to unravel catalytic active sites on some of these materials and the mechanisms by which they effectively catalyze some of these hard-to-catalyze reactions will be discussed.

Speakers Details:

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Tewodros (Teddy) Asefa completed his MSc as a Fulbright fellow in 1998 at the Department of Chemistry and the Institute for Lasers, Photonics and Biophotonics (ILPB). Teddy then went to Toronto to complete his Ph.D. at the University of Toronto in 2002 with Professor Geoffrey A. Ozin. While at Toronto, he co-invented new classes of nanocomposite materials called Periodic Mesoporous Organosilicas (PMOs) that have drawn a wide range of interest worldwide. He was then an invited Miller Fellowship nominee by Professor Peidong Yang at the University of California at Berkeley and a post-doctoral fellow at McGill University with Professor R. Bruce Lennox. He served for four years as an Assistant Professor of Chemistry at Syracuse University, before joining Rutgers University at New Brunswick, where he currently serves as a joint Full Professor in the Department of Chemistry and Chemical Biology and the Department of Chemical and Biochemical Engineering. His group at Rutgers is involved in the development of synthetic methods to a wide array of functional nanomaterials and the investigation of their potential applications in catalysis, nanomedicine, solar-cells, and environmental remediation. He held NSF CAREER Award, was the National Science Foundation American Competitiveness Fellow (NSF ACI) Fellow, is a recipient of multiple federal and local research grants and also serves as a panelist for several federal and international agencies, and as Editorial member of several scientific journals. He holds several patents, co-edited a book on Nanocatalysis (for Wiley) in 2013, and published over 190 peer-reviewed scientific papers and book chapters. He GoogleScholar citation record currently stands at over 18,200 with an h-Index of 58.