TcSUH Special Seminar

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Monday, May 6, 2019

Room 102, Houston Science Center, 1:30 p.m. – 2:30 p.m.

Advanced Materials for Production of Sustainable Fuel and Clean Water

ABSTRACT: CO_2 is a major greenhouse gas resultant from fossil fuel consumption. An ideal strategy to mitigate the global climate change is to convert CO_2 emissions back into fuels and useful chemicals. Photochemical and electrochemical reduction of CO_2 are promising approaches because renewable energy (e.g. solar and wind) can be used to produce sustainable fuel and solve the energy storage challenge simultaneously. However, the biggest challenge is the design of a high-performance and low-cost catalyst. In this seminar, we will summarize the recent progress in our research group in the development of efficient and inexpensive photocatalysts and electrocatalysts for CO_2 conversion to fuels, as well as mechanistic studies on the reaction mechanisms and pathways with the assistance of various *in situ* spectroscopy analyses. Energy-Water Nexus is another grand challenge we are facing. This seminar will also introduce some ongoing research in our group on low-cost, energy-efficient water treatment and sensing technologies. The ability of Li-ion batteries (LIBs) to provide portable high-density energy sources with outstanding cycle life has led to their deployment in recent electric vehicles (EVs). For wider consumer acceptance of EVs, however, the current state-of-the-art LIBs face formidable technological challenges, including concerns related to the battery cost, durability, and driving range. Resolving these hurdles requires substantial improvements in energy density, cycle life, and safety of current LIBs. Compared to the most widely accepted anode, graphite, cathodes suffer from inferior capacity, poor cycle life, thermal characteristics, and high cost. As a result, high-energy cathodes enabling a long cycle life and reliable safety need to be developed. Among them, a compositionally graded cathode material in which concentrations of the transition metals continuously varied from the particle center to the surface appears to be the most promising since the graded cathodes have demonstrated remarkable improvements over cathodes with single uniform composition, not only in lifetime and safety, but also in battery power due to the superior Li^+ diffusion kinetics. In this presentation, we review the most recent and promising results concerning NCA and NCM cathode materials. In addition, we introduce various compositionally graded cathodes and suggest the cathodes can enable production of batteries that meet the demanding performance and safety requirements of electric vehicles.

BIO: Dr. Ying Li is an Associate Professor, Pioneer Natural Resources Faculty Fellow, and Director of Graduate Programs in the J. Mike Walker ’66 Department of Mechanical Engineering at Texas A&M University. He obtained his B.S. degree in Thermal Engineering at Zhejiang University, China in 1999, his M.S. degree in Mechanical Engineering at Lehigh University in 2004, and his Ph.D. degree in Environmental Engineering Sciences at the University of Florida in 2007. He conducted his postdoc research on nanomaterials and catalysis at Washington University in St. Louis. In 2009, Dr. Li became a faculty in the Mechanical Engineering Department at the University of Wisconsin-Milwaukee (UWM), and moved to Texas A&M University in 2014. Dr. Li’s current research focuses on nanomaterials for energy and environmental applications, including catalysis, solar energy harvesting and conversion, carbon capture and utilization, water treatment, desalination, and sensors. He has published more than 70 refereed journal articles. He received NSF CAREER Award in 2013.

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