Departments of Physics and Math Colloquium

Interlayer-Expanded Molybdenum Disulfide Nanocomposites for Electrochemical Magnesium Storage

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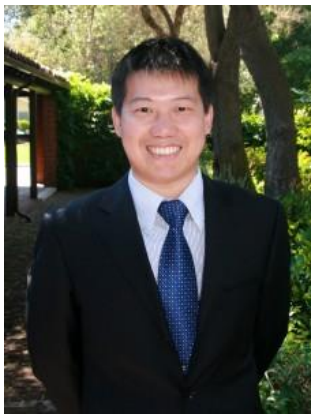

Friday, March 20, 2015
1:30 – 2:30 PM
Venue: GC 280, MMC
Refreshments will be served at 1:15 PM

Abstract: To meet surging demands for sustainable energy and clean environment, one critical requirement is to develop high-energy, safe and low-cost rechargeable batteries for electric transportation and grid energy storage. Mg rechargeable batteries (MgRBs) stand out as a promising candidate beyond lithium ion battery technologies due to high volumetric energy density, resource abundance, and the dendrite-free deposition behavior of Mg, which ensures safe operation. Many of the advantages of MgRBs originate from the divalent nature and small ionic size of Mg ions; however, these properties also render the cation too polarizing to diffuse easily in most ion-intercalation materials. In this talk, I will present interlayer expansion as a general and effective atomic-level lattice engineering approach to transform inactive layered intercalation hosts into efficient Mg storage materials without adverse side effects. We have combined theory, synthesis, electrochemical measurements, and kinetic analysis to improve Mg diffusion behavior in MoS_2, which is a poor Mg transporting material in its pristine form. The expansion boosts Mg conductivity by two orders of magnitude, effectively enabling the otherwise barely active MoS_2 to approach its theoretical storage capacity as well as to achieve one of the highest rate capabilities among Mg-intercalation materials. The interlayer expansion approach can be leveraged to a wide range of host materials for the storage of various ions, leading to novel intercalation chemistry and opening up new opportunities for the development of advanced materials for next-generation energy storage.

Biography: Dr. Yao joined University of Houston as an Assistant Professor in 2012. He got his bachelor and master degree in Materials Science from Fudan University in China in 2000 and 2003, respectively, and received his Ph.D. degree from University of California, Los Angeles in 2008. During his Ph.D. and industrial job at Polyera Corporation, he worked with Prof. Yang Yang and Dr. Antonio Facchetti on understanding organic device physics and synthesizing new polymerss for organic photovoltaics. From 2010 to 2012, he worked with Prof. Yi Cui at Stanford University on the novel nanostructure design for high-energy battery electrodes and efficient light trapping structures. Currently, his research focuses on materials discovery for energy applications in advanced batteries, solar cells, and catalysts. He received the US Office of Naval Research Young Investigator Award (2013), Robert A. Welch Professorship (2012), and an ARPA-E award.

The event is free and open to the public.

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