Electrochemical Energy Conversion and Storage: Materials Synthesis, Characterization and Performance

Electrochemical energy conversion and storage is important for developing an energy-sustainable society. Our group focuses on (electro)catalysis and rechargeable batteries. The research starts with materials synthesis, chemical/structural characterization, and performance assessments. This talk will consist of two topics: noble metal nanostructures for (electro)catalysis and electrode materials for advanced rechargeable batteries.

Highly dispersed noble metal nanostructures (such as Pd and Au), a group of important catalysts for many applications, are typically synthesized via top-down or bottom-up methods. Not many syntheses integrate the advantages of both strategies. Recently, we have developed such an unconventional method, which is entitled “alternating voltage induced electrochemical synthesis (AVIES)”. This method enables a simultaneous synthesis of both colloidal nanoparticles and nanostructured electrodes. I will discuss the synthesis, characterization, formation mechanism, and (electro)catalytic performance of a few noble metals.

Lithium ion batteries (LIBs), the most advanced rechargeable batteries, are currently ubiquitous in portable devices and will be popular in large-scale applications (such as electric vehicles) in the future. We are interested in both anode and cathode materials made of earth-abundant elements. This presentation will focus on alkali sulfide (M$_2$S, M = Li and Na) cathodes. M$_2$S cathodes are attractive for developing M-S batteries, because they can circumvent many issues associated with the direct use of metal anodes and sulfur cathodes. However, one big challenge towards realizing practical M$_2$S cathodes, which require both high specific capacity and capacity density, is the lack of an efficient method to produce M$_2$S secondary clusters – the entities of assembled M$_2$S nanoparticles. In this talk, I will demonstrate our progress towards this ultimate goal.
Dr. Yang is an Assistant Professor of Chemistry at Colorado School of Mines since 2010. He graduated in 1994 from the Chemistry Department of Nankai University, China, with a Bachelor Degree of Science. In 1999, he earned his PhD degree in Chemistry from the Institute of Photographic Chemistry, Chinese Academy of Sciences, Beijing. During 2000-2004, he was a postdoctoral fellow supported by the Humboldt Foundation and Max-Planck-Society, Germany, working with Prof. Helmut Baumgärtel at the Free University, Berlin and Prof. Klaus Kern at the Max-Plank-Institute for Solid State Research, Stuttgart. During 2004-2007, he worked as a postdoctoral associate at University of Florida with Prof. Charles Cao in the Chemistry Department. During 2007-2010, he was a research project scientist at University of California, Irvine, by working with Prof. Reg Penner in the Chemistry Department. His research interests and expertise include electrochemistry, inorganic synthesis, nanomaterials, advanced rechargeable batteries, and electrocatalysis. To date, he has authored 57 peer-reviewed publications; and his h-index is 24.