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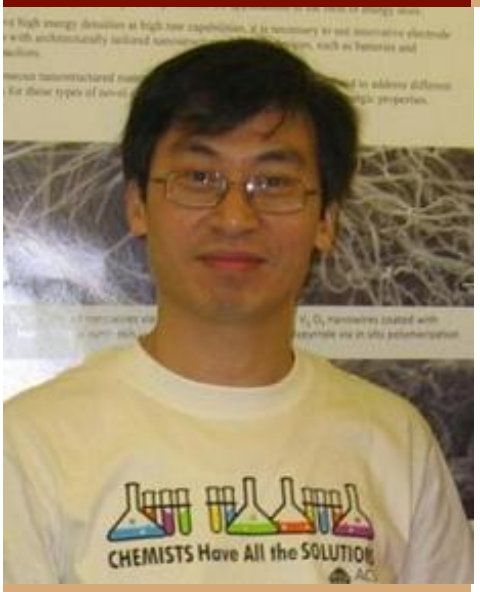
Heterogeneous Nanomaterials for Energy Storage Applications



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Abstract: To translate electrochemical energy storage devices onto a new performance curve, it is necessary to both bring a nanoscale perspective and integrate transport functions to the reaction interphases. In our studies, to effectively enhance the performance of electrochemical storage devices, materials have been transformed into nanomaterials and fine tuned concurrently in terms of chemistry and microstructure, and individual nanocomponents have been integrated to realize full potential of each component and achieve synergic properties. Due to its high specific capacity and low cost, manganese oxides are promising materials for electrochemical energy storage applications. To address their poor electrical conductivities, hierarchical manganese oxide/carbon nanofiber composites (MCNFs) were fabricated recently in our lab through a novel forcespinning and carbonization processes. These MCNFs containing MnO_x nanoparticles show a maximum specific capacitance of ~400 F/g in 1 M sodium sulfate electrolyte solution at a current density of 0.2 A/g. On the other hand, three-dimensional metal oxide core@shell nanoforests have been fabricated for EC energy storage. Detailed electrochemical measurements reveal that our nanoforests exhibit four times higher capacitance than the nanowire counterpart. The nanoforests also show great rate performance and small inner resistance. These special heterogeneous nanostructures enable electrodes with excellent electrical conductivity, large surface area and high active material loading. The above synergic characteristics enable these heterogeneous nanomaterials to be promising electrodes for electrochemical energy storage applications.

Biography: Dr. Yuanbing Mao has worked on the synthesis, and structural and property characterization of nanomaterials for more than 10 years. He received his Ph.D. in Chemistry in 2006. During his Ph.D. study, he developed three simple, reliable and generalized synthetic methodologies for various nanostructures, mostly transition metal oxides. Then as a postdoctoral scholar at UCLA, he synthesized rare-earth doped oxide nanostructures and studied the correlation between their luminescent properties and structural characteristics. After that, he worked at Washington State University on applied science for a little bit more than one year before joining the Department of Chemistry at UTPA as an assistant professor in 2010. Currently funded by DoD, ACS PRF, AFOSR, and Bill & Melinda Gates Foundation, his research group focuses on the development of multifunctional nanomaterials with application potentials related to sustainability and national security. He has over 35 peer-reviewed papers, 5 patents, one book chapter and more than 1150 citations with *h*-index > 35.