Structural Analyses of Nanomaterials for Aqueous Electrochemical Energy Storage

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Aqueous electrochemical energy storage (EES) devices using earth-abundant electrode materials, a low-cost and safe aqueous electrolyte and Na-ion as charge carrier, offer a transformational technology for portable electronics and transportation compared to non-aqueous Li-ion batteries (LIBs). In this presentation, I will present our recent results on the structural analysis of metal oxide nanomaterials, including faceted manganese oxides nanoparticles and layered manganese oxide and vanadium pentoxide nanostructures, for use as electrode materials for aqueous energy storage. Complementary tools including synchrotron/neutron scattering and pair distribution function analysis have been used to decipher the true electronic and crystalline structures of these materials. In particular, the charge-storage mechanisms of above nanomaterials during the electrochemical redox reactions in aqueous electrolytes have also been studied via time resolved X-ray absorption near edge spectroscopy (XANES) and X-ray diffraction (XRD) spectroscopy, which provide insight on the dynamic structure-function relationship of these materials during the charge-discharge processes.