Surface Oxidation of Metal Oxide Nanostructures for Improved Electrochemical Water Oxidation and Enhanced Exchange Anisotropy

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It is well known that the magnetic and electrochemical properties of nanomaterials are dependent on the crystallinity, particle size and morphology of the nanostructures.[1,2] A one pot synthetic methodology was established to obtain spherical Mn_3O_4 nanoparticles self-assembled into two-dimensional flakes and three-dimensional cubic morphologies. The surfactant concentration in the Mn_3O_4 nanostructures controls the extent of surface oxidation to give Mn_3O_4@Mn_2O_3 phases. The presence of different amount of e_g^1 electron in these nanostructures influences the electrochemical oxygen evolution reaction (OER) activity. The presence of e_g^1 electron gives rise to Jahn-Teller distorted structure facilitating high structural flexibility of the catalyst and provides the optimum strength of interaction between the catalyst and O_2 which is required for water oxidation.[3] In addition, the traditional magnetic ordering of Mn_3O_4 being ferrimagnetic, the oxidized antiferromagnetic shell of Mn_2O_3 exerts an exchange coupling at the interface, incorporating high magnetic anisotropy in the nanostructures. The superior performance of the Mn_3O_4@Mn_2O_3 self-assembled nanocubes will be discussed.

References:

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