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PhD Dissertation

Entitled

METAL OXIDE BASED MATERIALS FOR HIGH PERFORMANCE SUPERCAPACITORS

by

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Abstract

Recent years have seen a healthy rise in the research and development of sustainable and renewable energy storage systems due to the pressing need to conserve natural resources and cut energy use. Due to the rapid growth in global population lately, there is a tremendous demand for energy to fulfill the ever-increasing needs. Innovative alternative energy sources and energy storage techniques are of tremendous interest for dealing with these current world issues. One promising solution for this is the recent research trend for achieving reliable and cost-effective high power and high energy density energy storage devices. On the basis of their distinctive physical and chemical characteristics, such as conductivity, mechanical, thermal and cycle stability, nanostructured binary transition metal oxides (BTMOs) have recently been shown to be very attractive candidates for reliable and effective energy storage devices. The most innovative aspects of supercapacitor technology have been the vast choice of material, design, fabrication and synthesis of nanomaterials that make use of their outstanding electroactive nature, low cost, and higher efficiency. BTMOs are capable of producing highly efficient supercapacitor devices as a result of recent research and development. The primary goal of this dissertation research is to develop a facile, effective and affordable hydrothermal method for the synthesis of BTMOs nanostructured based supercapacitors. In detail, we have synthesized a number of composites e.g. polypyrrole-assisted Ag doping to $Co(OH)_2$ Nanosheets, Core-Shell Structure of Cobalt-Doped@MnO_2 Nanosheets, $MnCo_2O_4$/NiO Flower-Like Nanostructure Composites, core-shell-like CoMn2O4@MnS nanowire arrays, Mn-doped tetragonal ZrO_2 nanocrystals, Tungsten doped Cobalt based supercapacitor electrodes, Molybdenum doped Tin chloride based supercapacitor electrodes, Iron doped Lead oxide based supercapacitor electrodes and rGO doped ZnO based supercapacitor electrodes that yield promising morphological and electrochemical performances. We are hopeful that this dissertation will assist scientist and engineers to further explore the novel transition metal oxide and their promising as well as leading usage in energy storage applications.

Keywords: energy storage, supercapacitors, metal oxides, sustainable energy, nanomaterials