ABSTRACT

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Title: Preparation of Polyaniline Nanostructures for Energy and Charge-Transport Application.

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Nowadays, the development of efficient, clean, sustainable energy storage development has become an important challenge in energy research. A supercapacitor or an ultracapacitor is an ideal as well as prominent alternative candidate for energy storage applications because of significantly higher power density, fast charge/discharge rates and long lifespan. The charge-storage capacity of a supercapacitor is exclusively dependent on its electrode material and supporting electrolyte. Among conducting polymers, Polyaniline (PANI) is known as the most promising material for the application of supercapacitors, due to its excellent mechanical, thermal, size- and shape-dependent chemical, optical, and unusual electronic and transport properties. PANI nanostructures also have other potential applications like sensor, good adsorbent, catalyst, electro-catalyst and many others. However, apart from the application purpose, synthesis of eco-friendly, cost effective and efficient nanostructures are important issues nowadays. PANI is mostly popular as *p*-type conducting polymer, due to its many superior advantages such as good environmental stability, the ease of synthesis, low preparation cost, long range of electrical conductivity, and simple doping/dedoping chemistry *etc*. These advantages of PANI nanostructures, make more promising materials in application point of view.

The present thesis mainly deals with the synthesis of PANI nanocomposites and their applications as energy storage materials and charge-transport properties. Utilizing different organic carboxylic acid, especially benzine tetra-carboxylic acid (BTCA) and Guanosine mono phosphate (GMP) etc as dopant, several PANI nanostructures has been prepared. Depending upon the nature of dopant acids and molar ratio of dopant acid the morphology of PANI nanostructures have been tuned from agglomerate to nanotubes. Aromatic acid doped PANI nanotubes have been utilized for flexible solid-state supercapacitor to demonstrate the potential of these materials for real application. Metal nanoparticles (MNPs) coated PANI nanotubes have been developed on PANI surface by taking advantages of mild reducing property and stabilizing effect of PANI chains. The MNPs loading density on PANI surface has been optimized by changing w/w ratio of PANI to metal salt, to achieve maximum potential efficiency from the prepared nanocomposites. Prepared PANI/Ag nanocomposites reveled multiple resistive switching properties and transport mechanism has been elucidated of the temperature dependent studies.

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