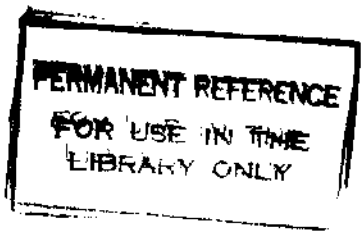
Thesis

PHYSICAL AND ELECTROCHEMICAL PROPERTIES OF POLYANILINES



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ABSTRACT

Polyaniline (PANI) has emerged as one of the most promising conductive polymer for commercial development. The oxidation states of PANI can be varied from fully reduced leucoemeradine base to the half oxidized emeraldine base and to the fully oxidized pernigraniline base form. In this study emeraldine base form of polyaniline was used as the starting material for the preparation of other oxidation and protonation forms. The fully oxidized form of poyaniline, pernigraniline base (PNB) has been prepared as a pure and stable powder. The protonated form of PNB has been obtained in highly acidic media by controlling the processing conditions such as solvent, temperature, drying procedure, etc. Conductivity measurements showed a metallic behaviour for the partially crystalline PNB salt form.

The thermal characteristics of emeraldine base form of PANI were studied by viscosity measurements, FTIR spectroscopy and thermogravimetric analysis. Thermal ageing of PANI results in a decrease in conductivity.

The electrochemical behaviour of chemically and electrochemically synthesized polyaniline films have been investigated in aqueous functionalized acid solutions. Cyclic

voltammograms of chemically and electrochemically synthesized PANI were found to be almost identical. PANI films obtained by these two processes were compared with respect to their conductivity and stability. The in-situ conductivity experiments enabled the determination of a finite window of conductivity for different functionalized acids.

Nanocomposite materials formed by cadmium sulfide (CdS) and copper sulfide (Cu_2S) with polyaniline were synthesized by chemical methods. CdS/PANI and Cu_2S/PANI nanocomposites were prepared by incorporating Li_2S, $Cd(CF_3SO_3)_2$ and $Cu(CF_3SO_3)_2$ in PANI. Particle sizes of CdS and Cu_2S can be varied using this method. These nanocrystal sizes were obtained by TEM and XRD. The nanocomposites show good stability and high absorption in the visible light spectrum. The use of nanocrystals allows great flexibility in controlling the performance of photovoltaic devices by changing the nanocrystal size, concentration, and the material of the nanocrystals.