# THE EFFECT OF POLYMERIZATION TEMPERATURE ON THE POTENTIAL CYCLING BEHAVIOUR AND OPTICAL ABSORPTION SPECTRA OF SOME POLYPYRROLE FILMS

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The properties of polypyrrole (PPy) are strongly influenced by the nature of the doping ions as well as preparation conditions such as electrolyte concentration, current density and temperature used during polymerization. In spite of the tremendous amount of work on conducting polymers, there are still considerable differences between the results reported with regard to their properties in the literature.

In this paper, systematic investigation about the influence of the polymerization temperature on potential cycling behaviour as well as the stability of PPy films doped with a large detergent anions, dodecylebenzenesulfonate ($DBS^-$), using cyclic voltammetry is reported. The PPy films were prepared on Pt wire at different temperatures by the galvanostatic method with a polymerization charge of 0.16 C $cm^{-2}$ in aqueous solution containing $DBS^-$ dopant species. Cycling test was carried out in 0.5 M $NaClO_4$ aqueous electrolyte at room temperature. The cycling was repeated several times for each sample (prepared at 2, 25 and 60 °C) to investigate the stability of films. For hundreds of continuous cycles, the position of the peaks and cycling capacity remained unchanged indicating the high stability of the films.

In the cyclic voltammograms, there is a pair of peaks on both positive and negative sweeps, and they are well pronounced for the films prepared at low temperatures. However, the second oxidation peak becomes less pronounced, and the reduction peak becomes more prominent as the polymerization temperature increases. In addition, the potential of the reduction peak is shifted towards more negative potential, and the corresponding capacity of the peak increases gradually during the negative sweeps as the polymerization temperature increases. The cycling charges were also found to decrease with increasing synthesis temperature. Therefore, the cyclic voltammograms of PPy/DBS films are significantly affected by the polymerization temperature. The results imply that the films formed at higher temperatures are less perfect and less conjugated due to structural defects such as cross linking between polymer chains, which results in a decrease in length of conjugated segments. Similar results were reported for PNMP/$ClO_4$ films by our group earlier.

Optical absorption spectral studies of PPy/DBS films on ITO glass using a specially designed Teflon cell were performed. The absorption spectra were obtained at different states (reduced, partially oxidized and oxidized) of the PPy/DBS films. In the reduced state, an energy gap of 3.05 eV corresponding to a strong $\pi$-$\pi^*$ transition was observed. In the conducting state, a broad absorption peak was present at 1.29 eV, indicating the bipolaron formation during oxidation.

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