INVESTIGATION OF SOLVENT-INDUCED SWELLING OF POLYPYRROLE THIN FILMS BY DRT ANALYSIS OF ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY DATA

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Conducting polymers, such as polypyrrole(Ppy) are increasingly employed in modern bioelectronic devices [1]. However, their performance can be strongly affected by solvent induced swelling and the associated structural changes in the polymer matrix. One of the key challenges in such systems is therefore evaluating their robustness and stability in different media by characterizing the effect of pH, solvent or electrolyte-induced changes in the polymer matrix [2].

In this work, thin films of conducting polymer polypyrrole were electrochemically deposed onto screen printed carbon electrodes (SPCE). After synthesis, the Ppy/SPCE system was exposed to electrolyte solutions containing increasing concentrations of ethanol as a cosolvent. Fast Fourier transform electrochemical impedance spectroscopy (FFT-EIS) was applied to rapidly monitor time dependent changes in the electrochemical system.

For the analysis of the acquired EIS data, the two employed approaches were non-linear least squares fitting using equivalent circuit models and distribution of relaxation times (DRT) analysis [3]. Equivalent circuit model fitting provides information about changes in charge-transfer resistance, electric double-layer capacitance, and mass-transport limitations. In contrast, DRT analysis reveals dynamic shifts in the underlying relaxation processes of the Ppy/SPCE system without relying on a predefined equivalent circuit model. The combined data analysis provides valuable insights into ethanol-induced polymer swelling and reorganization of the Ppy film.

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