

Reproducibility of the electrochemical doping process of polypyrrole / dodecylbenzenesulfonate

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Polypyrrole films prepared using large anionic surfactant dodecylbenzenesulfonate (DBS) have been shown to be strong candidates for use in soft actuators known as artificial muscles. However for the successful use of an actuator, it is important to have a precise understanding and control of the ionic species, which are mobile during actuation process. The muscle reversibility and stability also constitute major issues in the development of the smart actuators.

In the present paper, the electrochemical redox mechanism of dodecylbenzenesulfonate doped polypyrrole (PPy/DBS) has been studied by using Electrochemical Quartz Crystal Microbalance (EQCM). EQCM is a very sensitive in situ piezoelectric tool capable of detecting nanogram range mass changes through measuring the in-situ frequency changes of the quartz resonator. Doping and dedoping of the film is achieved by cyclic voltammetry. In order to distinguish the nature of inserted / deinserted species two different salts were used as aqueous electrolytes. The analysis of the results indicated that the surfactant counter anions were trapped in the polymer matrix and that both anions and cations of the electrolyte play an important role in the redox process. The kinetics of the electrochemical doping of the PPy/DBS films also depends on the history of the electrochemical events undergone by the film. The influence of different parameters [Wait-time at the starting potential, number of cycles] on the redox process is described and the conditions for obtaining reproducible results have been identified. With respect to the polymer redox behavior in monomer free electrolyte solutions, the overall behavior is almost reversible after a certain number of initial cycling.

We acknowledge the financial assistance from National Science Foundation, Sri Lanka and International Programme for Physical Sciences, Uppsala University, Sweden.

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