

A cyclic voltammetry study of polypyrrole conducting polymer film in aqueous BaCl₂ and LiCl electrolytes

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The emergence of electronically conducting polymers having fascinating properties has opened up a novel class of polymers suitable for modern applications, including smart soft actuators or ‘artificial muscles’. The change in volume of these polymers when the redox state is altered in aqueous electrolytes is exploited in these actuators. The actuation property of these polymers highly depends on cycling electrolytes, types and concentrations. The present study aims to explore the possibilities to use Polypyrrole, doped with the immobile anion dodecyl benzene sulfonate (PPy/DBS) films cycled in LiCl and BaCl₂ electrolytes. In this study, PPy (DBS) films of thickness 400 nm were electropolymerized on 6 MHz AT-cut quartz crystal electrodes from a synthesized solution containing 0.05 M pyrrole monomer in 0.05 M NaDBS solution and characterized by simultaneous cyclic voltammetry and Electrochemical Quartz Crystal Microbalance (EQCM) measurements. The films were cycled in 0.1 M BaCl₂ 0.1 M LiCl, 2 M LiCl and 1 M BaCl₂ electrolytes. The actuation mechanism of the film in LiCl electrolytes (up to 2M concentrations) is exclusively based on cations motions while that in BaCl₂ (up to 1M concentrations) is contributed with both cations and anions in electrolytes. It implies that the redox ionic motion resulting from the actuation of PPy (DBS) films is not exclusively based on metallic ion presence in the electrolyte but depends on the type of metallic ions present in the cycling electrolytes used. When comparing with high and low concentrations in LiCl and BaCl₂, a larger frequency change was obtained in low concentrations rather than in higher concentrations, indicating that the actuation in thin concentrations is larger than higher.