

E1-02: Electrochemical preparation and characterization of polypyrrole in aqueous solutions

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Polypyrrole is one of the popular electronically conducting polymers for a number of reasons. It can be electrochemically synthesized. It is thermally stable, can be easily doped without employing hazardous oxidants, and it also

has a high electrical conductivity. The electrochemical approach had the advantage that the properties of the film can be changed by varying the electrolysis conditions (i.e. electrode potential, current density, solvent, electrolyte) in a controlled way.

Polypyrrole was usually prepared electrochemically in non-aqueous organic solvent such as acetonitrile or propylene carbonate, and relatively few polymerizations were reported in aqueous solutions.

In this paper, the synthesis of conducting polypyrrole films on Pt electrodes from deoxygenated solutions of 0.1 M aqueous background electrolytes containing pyrrole, is reported. Polypyrrole films with a thickness of 0.25 μm were obtained by the galvanostatic polymerization of pyrrole in an aqueous electrolyte with LiClO_4 as the anionic counter ion. The pH of the electrolyte was controlled by adding HClO_4 and the effect of pH on polymerization was investigated. The influence of the polymerization current density on the properties of the film was studied with a constant electrolyte/monomer concentration (0.5 M LiClO_4 in H_2O) and varying the current density from 31.25 $\mu\text{A}/\text{cm}^2$ to 2000 $\mu\text{A}/\text{cm}^2$. The films formed were characterized using cyclic voltammetry.

The polymerization of pyrrole was affected by the pH of the electrolyte and good films were obtained with pH 4. The films formed were strongly electrochromic with two distinct colour stages in the potential range -0.80 V to +0.60 V versus SCE. The transition from pale yellow to black occurred at about -0.35 V with respect to SCE. Two types of polypyrrole films were obtained, as in the previous study with the dry propylene carbonate as a solvent, depending on the current density used during the polymerization. The high current form was obtained for current densities $> 250 \mu\text{A}/\text{cm}^2$ and the low current form, film with high conjugation was obtained with current densities 50 $\mu\text{A}/\text{cm}^2$. At very low current densities the polymerization was found to be poor as a minimum current may be needed to overcome the parasitic reactions.