Supercapacitive Properties of Nanostructured Polypyrrole Formed By Templateless Electropolymerization.

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Due to their potential applications, nanostructured conductive polymers have attracted growing attention. Up to now, conductive polymer nanostructures were primarily obtained using 'hard' templates (such as zeolites, track-etched polymeric membranes and alumina films containing anodically etched pores) or 'soft' templates (surfactant molecules that spontaneously organize into micelles when their concentration reaches a critical value or liquid-crystalline phases).

In this presentation, it will be shown that the direct electrodeposition of (oriented) polypyrrole nanowires can be achieved without using a template (Fig. 1). These structures are obtained by electrochemical oxidation of pyrrole in the presence of jointly weak-acid (HPO_4^{2-}) and non-acid anions (ClO_4^-). Notice that if only weak-acid anions are present in the electrolyte, an ultra thin (10 nm) film of overoxidized polypyrrole is deposited on the electrode [1]. The growth mechanism of the polypyrrole nanostructures will be discussed. Notably, it will be highlighted that the presence, at the electrode-solution interface, of weak-acid anions is essential and that, at the beginning of the process, water oxidation which leads to hydroxyl radicals and O_2 evolution should occur [2]. It will be shown that the variation of the interfacial pH, due to pyrrole oxidation, is the key point of the process. These nanostructured PPy films are promising electrode materials for supercapacitors (see Figs. 2 and 3).

[1] C. Debiemme-Chouvy, Electrochem. Solid State Lett. 2007, 10 E24-E26.
[2] C. Debiemme-Chouvy, Electrochem. Comm. 2009, 11, 298-301.

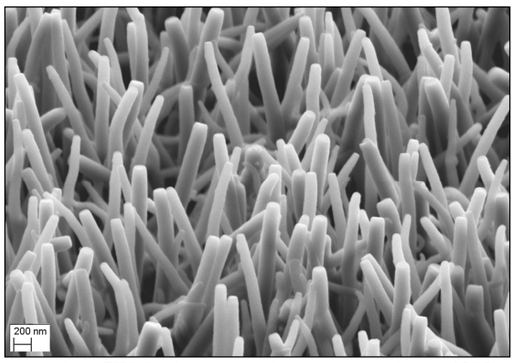

Figure 1: SEM image of cross-section (65°) of polypyrrole nanowires electrochemically synthesized without the use of template.

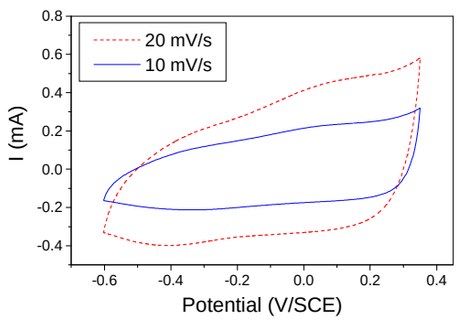

Figure 2: CVs obtained at a PPy/Pt electrode in 0.2M $LiClO_4$ aqueous solution. Electrode surface: 0.07cm^2.

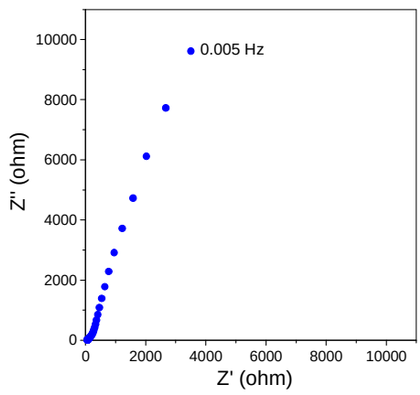

Figure 3: EIS spectrum recorded at PPy/Pt electrode in 0.2M $LiClO_4$ aqueous solution. $E_{applied}$ = -0.2 V/ECS.