Comparison of Conductivities of Bulk and Nanowire Morphologies of Electrodeposited Polypyrrole

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Conducting polymers have been extensively studied due to their widespread potential applications such as sensors, compact electronic devices and energy storage[1]. Nanostructured materials, like polypyrrole, result in improved analytical characteristics of a polymer[2]. Important factors in the production of nanowire morphology include the pH at the electrode/electrolyte interface[3], the concentration of dopant ions and pyrrole, the applied potential and the time of deposition.

Polypyrrole nanowires were electrodeposited on gold electrodes using slightly acidic anions (Na_2HPO_4) and non-acidic anions ($LiClO_4$) at a fixed potential of 0.80 V vs SCE. The nanowires produced had an average diameter of 89.2nm (n = 50). Bulk polypyrrole was electrodeposited using similar conditions but the pH of the solution system was reduced using concentrated $HCLO_4$. As shown in Figure 1, the SEM micrographs of the bulk and nanowire polypyrrole films are very different.

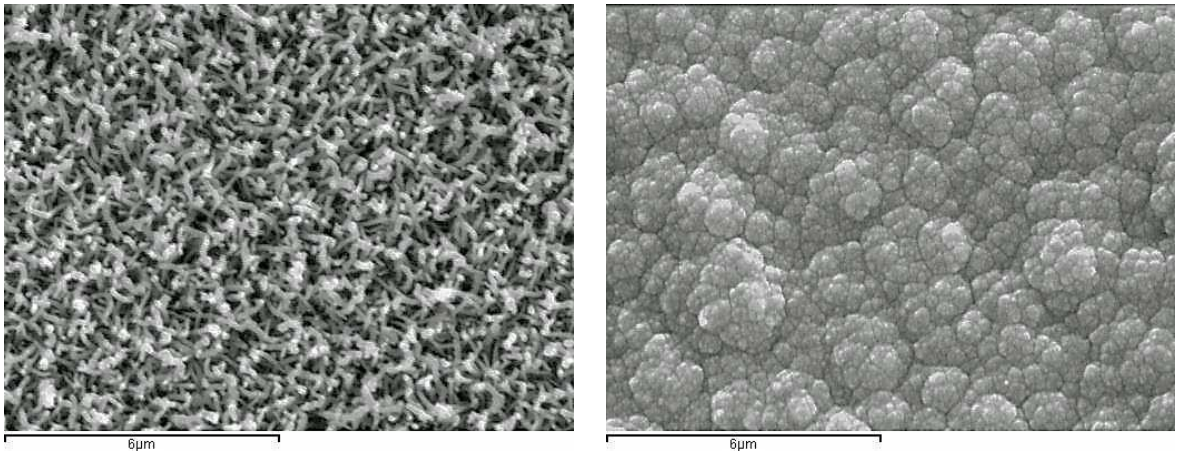

Figure 1: Nanowire and Bulk Morphologies of Polypyrrole

Electrochemical Impedance Spectroscopy experiments were carried out on a bare gold electrode, bulk polypyrrole and polypyrrole nanowires in order to compare their conductivities. The impedance data were analysed using equivalent circuits. Using these results, the conductivities of the systems were calculated. The influence of different electrolytes on the impedance were also studied.

References:

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3. C. Debiemme-Chouvy, Electrochemistry Communications, 2009, 11, 298-301.