Electrodeposition of Polyaniline nanowires

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Abstract

Electrochemical supercapacitors are the charge-storage devices having high power density. The nano scale materials with high surface area and high porosity, give the best performances as electrode materials for supercapacitors due to their distinctive characteristics of conducting pathways and nano scale dimensions. Therefore, the synthesis and capacitive characterization of the high surface area nanomaterials such as nanowires have been carried out extensively.

In this research, polyaniline nanowires were electrochemically deposited on stainless steel electrode with the technique of choronoamperometry and pulse voltammetry and characterized by cyclic voltammetry and charge-discharge cycling for supercapacitive properties. The mechanism of electrodeposition was analyzed by cyclic voltammetry and chronoamperometry techniques. The morphology of coatings was investigated by scanning electron microscopy (SEM).

It was determined that electrodeposition is controlled by diffusion with a limited and steady state current and the mechanism of nucleation is absolutely uniform. SEM images of the polyaniline nanowires show that the diameter of the nanowires is in the range of 40-70 nm. The PANI nanowire arrayed electrodes have excellent specific capacitanceand high efficiency of charge/discharge cycling which is very important for the electrode materials of a capacitor to provide high power density.

Keywords: polyaniline, nanowire, supercapacitors, electrodeposition

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Figures

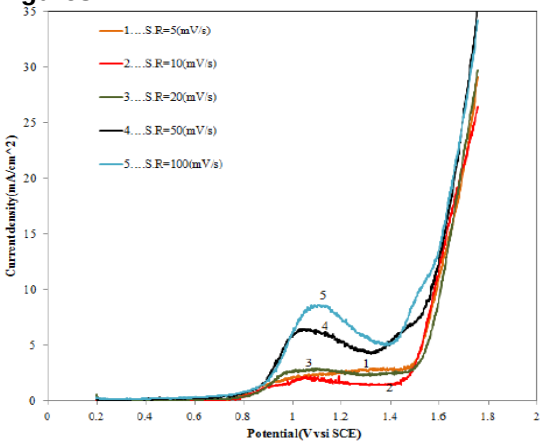


Figure 1. Cyclic voltammetry curves for polymerization of polyaniline in different scan rates

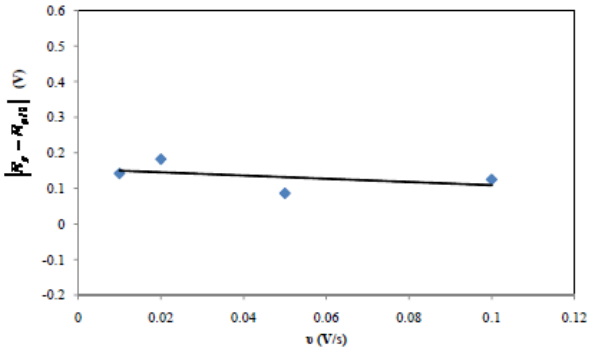


Figure 2. Variation of $|E_p-E_{p/2}|$ versus scan rate

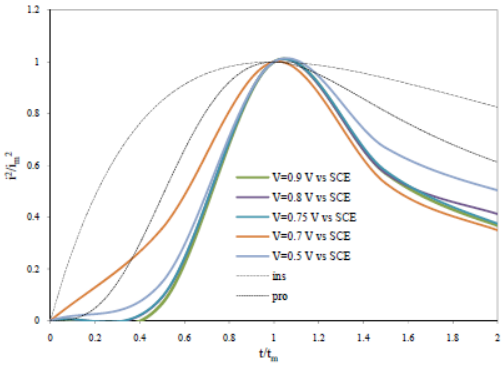
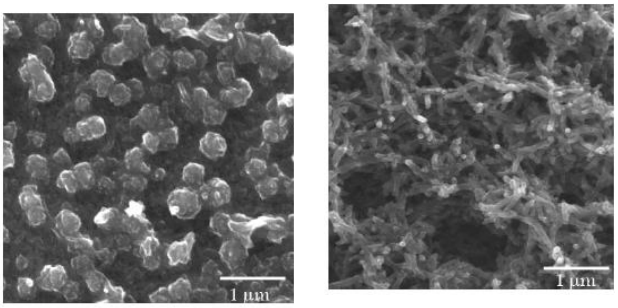


Figure 3. Variation of I^2/I^2_m versus t/t_m in different potentials



(a) (b)

Figure 4. Scanning electron microscopy (SEM) of polyaniline achieved by chronoamperometry techniques at a) 70mV b) 75mV in 15 minutes

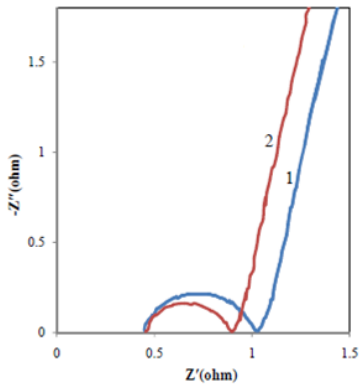


Figure 5. Nyquist curgves for polyaniline nanowires achieved by pulse voltammetry and chronoamperometry techniques

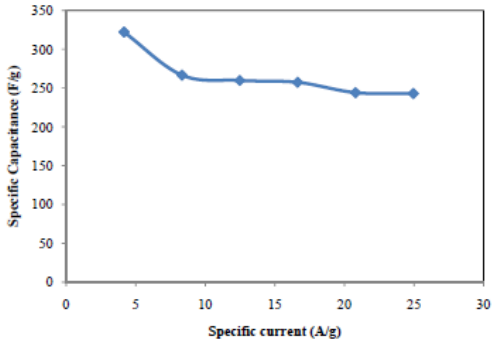


Figure 6. Variation of specific capacitance versus specific current for polyaniline prepared by chronoamperometry technique