Electrodeposited Polyaniline in a Nanoporous WO3 Matrix: An Organic/Inorganic Hybrid Exhibiting Both p- and n-Type Photoelectrochemical Activity

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Abstract

This study focuses on the electrodeposition of a conducting polymer such as polyaniline (PANI) into a tungsten trioxide nanoporous host framework. Nanoporous WO3 films were initially electrosynthesized on tungsten foil by anodization at different voltages in a fluoride-containing medium. The PANI layer was electrografted onto the entire surface of the WO3 using potentiodynamic electrodeposition in sulfuric acid electrolyte. The morphological features of oligomer/polymer formed in the nanoporous oxide template were monitored by field-emission scanning electron microscopy. Systematic changes in the morphology afforded insights into the evolution of the WO3/PANI hybrid assembly. This assembly was subsequently characterized by Raman spectroscopy, X-ray photoelectron spectroscopy, cyclic voltammetry, and photoelectrochemical measurements. Photovoltammetric data indicated the complex behavior of the hybrid, featuring the properties of both of its components: namely, p-type behavior in the cathodic polarization regime and n-type behavior at the anodic end. Moreover, much higher cathodic photocurrents were observed for PANI in the hybrid configuration (compared to neat PANI itself), in which effective charge separation manifested in the shape of the photocurrent transients.