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RESEARCH ARTICLE

Electrodeposition and characterization of nickel–copper metallic foams for application as electrodes for supercapacitors

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Abstract Nickel–copper metallic foams were electrodeposited from an acidic electrolyte, using hydrogen bubble evolution as a dynamic template. Their morphology and chemical composition was studied by scanning electron microscopy and related to the deposition parameters (applied current density and deposition time). For high currents densities (above 1 A cm^{-2}) the nickel–copper deposits have a three-dimensional foam-like morphology with randomly distributed nearly-circular pores whose walls present an open dendritic structure. The nickel–copper foams are crystalline and composed of pure nickel and a copper-rich phase containing nickel in solid solution. The electrochemical behaviour of the material was studied by cyclic voltammetry and chronopotentiometry (charge–discharge curves) aiming at its application as a positive electrode for supercapacitors. Cyclic voltammograms showed that the Ni–Cu foams have a pseudocapacitive behaviour. The specific capacitance was calculated from charge–discharge data and the best value (105 F g^{-1} at 1 mA cm^{-2}) was obtained for nickel–copper foams deposited at 1.8 A cm^{-2} for 180 s. Cycling stability of these foams was also assessed and they present a 90 % capacitance retention after 10,000 cycles at 10 mA cm^{-2}.

Keywords Nickel–copper · Nanostructured foams · Electrodeposition · Electrodes for supercapacitors