Ni-Co OXIDES FOR HIGH PERFORMANCE FLEXIBLE SUPERCAPACITOR ELECTRODES

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ABSTRACT

Flexible supercapacitors have been receiving extensive attention due to their suitability as the power supply for portable and wearable electrical devices[1]. Hence, high-performance supercapacitor materials, offering a good compromise between energy density and cycle life, have to be integrated on flexible substrates[2]. Despite many advances, research and development of flexible electrodes are still in their infancy. Metal and binary metal oxides are promising porous precursors for the construction of these functional electrode materials. In particular, nickel cobaltite ($NiCo_2O_4$, NCO) has shown promising pseudocapacitive properties, high electrical conductivity, and large surface by virtue of its effective porous structure[3]. In the present study, the main aim has been the fabrication of flexible-bendable and stable NCO-based supercapacitor electrodes. Uniform $NiCo_2O_4$ films were deposited on flexible substrate (PolyImide, PI – Kapton^{TM}) with interlayer Au (NCO/Au/KaptonTM) from dispersions of hydrothermally produced nanoparticles of the mixed oxide, by an appropriately optimized inkjet printing technique. We have explored the effect of thickness film (applying three 0.1, 0.3 and 0.5 mg cm^{-2} loadings) on the pseudocapacitive behaviour of these electrodes. The morphological characterization via AFM images demonstrates that the NCO nanoparticle films are well-suited to provide rich reaction sites and short ion diffusion paths and the surface roughness of the material (NCO) in the regions of homogeneous cover is clear and expected for a particulate film. Indeed, the printed NCO films allowed for good electrochemical performance as investigated via cyclic voltammetry, galvanostatic charge-discharge and electrochemical impedance spectroscopy (***Figure 1***). Flexible-bendable and optimized (for film stability and conductivity) NCO/Au/Kapton^{TM} electrodes delivered an areal capacitance 172 mF cm^{-2} at a charge/discharge current density of 1 mA cm^{-2}, very high mass-specific capacitance values that could reach 520 Fg^{-1} in the range 0.3 - 0.5 mg cm^{-2} and promisingly stable over 800 cycles at 1 mA cm^{-2}.

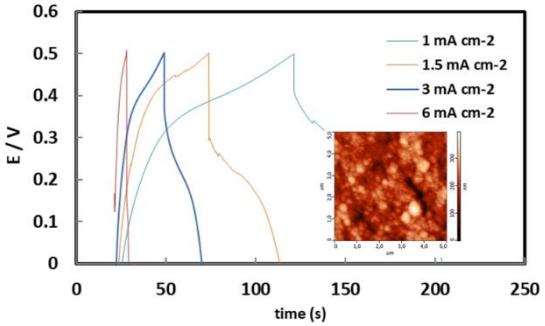

Figure 1. Galvanostatic charge-discharge curves and AFM topography of NCO/Au/Kapton.

KEYWORDS: semi-transparent electrodes, flexible electrodes, supercapacitors, nickel cobaltite

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