Highly Branched 3D-Dendritic Structures of Co-Ni for Redox Supercapacitor Electrodes: Fabrication, Characterization and Electrochemical Response

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ABSTRACT: Highly branched 3D dendritic Co-Ni electrodes for supercapacitors were successfully prepared, by co-electrodeposition, on stainless steel current collectors in the cathodic domain using a square current waveform. The morphology and composition of the electrodeposited films change after repetitive potential cycling. In fact, after cycling, there is formation of thin nanoplates mainly composed of oxi-hydroxides and hydroxides of Co and Ni, over the 3D dendritic structure. The electrochemical response reveals the presence of redox peaks assigned to the oxidation and reduction of Ni and Co oxi-hydroxides and hydroxides in the surface film. Both species, when combined, display electrochemical activity in a larger potential window, comparatively to that of the respective single oxides. The capacitance of the 3D dendritic Co-Ni films results from faradaic reactions involving both cobalt and nickel centres in the surface film, and attains values of 570 F g-1. Moreover, after long-term charge/discharge cycling, capacitance retention is above 70%, stating the good performance of these materials and their suitability as supercapacitor electrodes. Electrochemical impedance spectroscopy shows that the electrochemical response of the electrode changes with the applied bias, reflecting the different state-of-charge. When the material is fully charged EIS highlights the electrode capacitive response. The approach presented in this work represents a significant contribution for the fabrication and tailoring of supercapacitors electrodes presenting high specific capacitances and displaying enhanced electrochemical response.