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Nanoporous copper-cobalt mixed oxide nanorod bundles as high performance pseudocapacitive electrodes

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ABSTRACT:

We used a simple, cost effective and scalable chemical method to deposit **mixed oxides** of copper and cobalt on indiumtin oxide (ITO) and stainless steel (ss) substrates. The depositedmixed oxides of Cu-Co and Co-Cu exhibit uniform surface morphology with nanoporous structure as obtained from scanning electron microscopy (SEM). The electrochemical properties were characterized by cyclic voltammetry (CV), galvanostatic charge-discharge (GCD) and electrochemical impedance spectroscopy (EIS). The Cu-Co oxide film on ITO yielded very high specific and volumetric capacitances of 919 Fg^{-1} and 616.1 Fcm^{-3} respectively with high energy (28.78 Wh kg^{-1}) and power (51.8Wkg^{-1}) densities. The same oxide on ss yields 195 Fg^{-1} and 236.8 Fcm^{-3} respectively for the specific and volumetric capacitances. In addition, the Cu-Co oxide electrode shows superior rate capability and excellent long-term cyclability. While the ss offers less internal resistance, the stability of the films is higher on ITO substrates. The bundles of rod-like Cu-Co mixed oxide embedded with nanoporous structure exposed more active surfaces with minimal ion diffusion length thereby enhancing the redox behavior and the binary oxides are synergistically responsible for superior rate capability and excellent durability. Our results indicate that these nanoporous electrodes are promising for use in pseudocapacitive applications.