ORD102

Chromium nitride deposition onto silicon pyramids for supercapacitor applications

Emile HAYE[1], Abdelouadoud GUERRA[2], Amine ACHOUR[1], Jean-Jacques PIREAUX[1], Stéphane LUCAS[3]

[1]UNamur, NAMUR, Belgium [2]CRTSE, Alger, Algeria [3]Unamur, NAMUR, Belgium

emile.haye@unamur.be

Transition metal nitrides are widely studied materials for electrochemical capacitors (ECs), due to their good electrochemical performance and good cycling life stability. In addition, they are easy to synthesize, especially by magnetron sputtering. However, the dense nature of the coating deposited by sputtering is one of the limiting factors to achieve high specific capacitance. One of the solutions to increase the capacitance lies in the increase of the specific surface either of the active material – as recently reported in the glancing angle deposition of CrN to obtain porous film [1] – or of the substrate, prior to deposition. In this view, we report the use of silicon pyramids coated with chromium nitride for supercapacitor applications. The well-defined micrometer-sized silicon pyramids are synthesized by fast and low-cost chemical etching and are coated by reactive magnetron sputtering of chromium in argon and nitrogen. The resulting CrN@3D silicon Pyramids core-shell have been characterized by X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), X-ray diffraction (XRD), and electrochemical characterization. A high specific capacitance of 187.5 $mF.cm^{-2}$ is obtained on 0.5M H_2SO_4 electrolyte at scan rate of 2 $mV.s^{-1}$ (92.6 at current density of 0.6 $mA.cm^{-2}$) with excellent stability over 10000 cycles. In addition, a solid-state symmetric device have been assembled with CrN@PySi electrodes and exhibits a high areal capacitance of 140.2 $mF.cm^{-2}$ at a scan rate of 2 $mV.s^{-1}$, with a high energy density of 8 $\mu Wh.cm^{-2}$ at a power density of 240 $\mu W.cm^{-2}$ with long cycle life (10000 cycles). The combination of CrN coating and Si pyramids appears thus to be a potential solution for low-cost energy storage applications.

Keywords
CrN
transition metal nitride
electrochemical capacitor