Macroporous carbon monoliths derived from phloroglucinol–sucrose resins as binder-free thick electrodes for supercapacitors

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ABSTRACT

Herein, we report the preparation of phosphate-functionalized monolithic carbons containing interconnected pores of different sizes (macro- and micropores) by the pyrolysis of phloroglucinol–formaldehyde and phloroglucinol–sucrose–formaldehyde resins. Carbons were characterized by X-ray diffractometry, Raman spectroscopy, nitrogen adsorption–desorption and scanning electron microscopy. The addition of sucrose led to a significant decrease in the specific surface area of the carbon monoliths but improved their mechanical properties. This allowed their processability into disk-shaped monoliths of 1.1 mm thickness, which were directly tested as binder-free electrodes for electrical double-layer capacitors without the addition of any conductive additive. The electrochemical properties of the monoliths were studied by cyclic voltammetry, galvanostatic charge–discharge and electrochemical impedance spectroscopy using a two-electrode configuration and 2 M H₂SO₄ aqueous solution as the electrolyte. The electrodes were cycled within the 1.4 V voltage window showing specific capacitances of ca. 250 and 110 F g⁻¹ at current densities of 0.2 and 10 A g⁻¹ (7 and 350 mA cm⁻²), respectively, and exhibited an excellent cycling stability with a capacity retention of 97% after 7500 charge–discharge cycles.

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