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The effect of vacuum annealing and HDDR processing on the electrochemical characteristics of activated carbon and graphene oxide for the production of supercapacitors electrodes

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Electric double-layer capacitors or electrochemical supercapacitors prepared using activated carbons have been subjected to vacuum heat treatments at low and high temperatures (200, 400, 600, 800 and 1000°C). The activated carbon electrodes have been tested at a window potential of 1.1 V employing a KOH electrolyte (1.0 mol.L-1). The effect of thermal treatment (vacuum or HDDR) upon the electrical properties has been investigated by cyclic voltammetry and electrochemical impedance spectroscopy (EIS). It has been shown that the specific capacitance at 5 msV-1 increases from 50 Fg-1 to 130 Fg-1 after a heat treatment at 400°C for 1 hour under back pump vacuum. At this temperature the diminution in the specific capacitance with higher scanning rate (10 msV-1) was much less pronounced (from 130 Fg-1 to 109 Fg-1). Equivalent series resistance (ESR) and equivalent parallel resistance of supercapacitors electrodes have also been investigated. Internal resistances of the supercapacitors were calculated using the galvanostatic curves at several current densities (10-100 mAg-1). BET analysis of the starting carbon and after thermal treatments have also been carried out in this investigation. The activated structures have been studied using scanning electron macroscopy (SEM) and X-ray diffraction. A compositional and morphological evaluation of these electrodes showed no significant change on the activated carbon structure. Reduced graphene oxide electrodes have also been prepared in this investigation for a comparison.