Abstract Description

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Electrochemical storage of energy in acrylic activated carbon fibres and activated carbons made from industrial residues

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In this work the application as electrochemical capacitors of novel materials, never tested before for this propose, were investigated using classic cyclic voltammetry, chrono potentiometry, chrono amperometry and electrochemical impedance spectroscopy. The tested materials were prepared in our laboratory: a) acrylic activated carbon fibres (ACF) (samples F920, F932, F993) produced from a commercial acrylic fiber by carbon dioxide activation at 900ºC according the procedure described in ref. 1; b) activated carbons (AC) produced from a coffee industry residue, the coffee endocarp, by carbon dioxide activation (samples C823, C840, C863) and KOH activation (samples AQ62, AQ605) (please see ref. 2 for experimental details). All the materials were easily produced in monolithic shape that can be considered an advantage over other materials because the electrode pos-production step and the use of binders are not needed.

The carbon materials textural, structural and chemical characteristics were very different between samples with apparent BET surface area, A_{BET}, range from 89 to 1050m^2/g, micropore volume given by α_S method, V_S, between 0.04 and 0.50cm^3/g, oxygen and nitrogen content in the range 7-16 and 1-8wt%, respectively, and microcrystalline dimensions L_a and L_c within the limits 2-4 and 1-4nm, respectively.

The higher specific capacitance was observed for samples C823, C840 and C863. The determined values were 149, 176 and 167 F/g, respectively. Apparently, ACF perform worse than AC as indicated by lower capacitance determined that reaches the maximum value of 90F/g at scan rate of 1mV/s. Nevertheless, the specific capacitance increases with A_{BET} and V_S increase, independently of the material, which could indicate that the porous properties are the determinant factor to the capacitance performance of this type of carbon materials. The heteroatoms content have peculiar influence, as for instance the specific capacitance shows an increase with oxygen content for ACF samples and an opposite trend for AC samples. Taking into account the medium microcristalite area, evaluated by $L_a x L_c$, we can observe higher values of capacitance for bigger areas. This tendency is mainly due to the incremented ability for charge accumulation in denser aromatic structures.

The obtained voltammograms show a slightly distorted rectangular shape with no distinct peaks. The distortion is more visible in the redox part of the curve, which proves of the presence of pseudocapacitance phenomenon.

During CESEP07 we will also show the results of electrochemical and liquid phase oxidation in the electrochemical capacitors behaviour. As main conclusion we can refer the high potential of the novel carbon materials tested that must be improved by enlarging the mean pore width in order to facilitate the electrolyte wetting and faster ionic motion within the material structure.

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Keywords: supercapacitors; carbon materials; industrial residues.

[1] P.J.M. Carrott, J.M.V. Nabais, M.M.L. Ribeiro Carrott, J.A. Pajares, Preparation of activated carbon fibres from acrylic textile fibres, Carbon 39 (2001) 1543-1555.

[2] J.M.V. Nabais, P.J.M. Carrott, M.M.L. Ribeiro Carrott, V. Luz, A. Ortiz, Production and characterisation of activated carbons made from coffee industry residues, Carbon 2006 Extented Abstract (2006) 181-185.