High power supercapacitor activated carbon electrodes”

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Due to their high power ability, carbon-carbon supercapacitors are more and more involved in numerous projects where batteries are insufficient to supply the power needed. Automotive applications are especially pointed out: start up assistance, brake energy recovery… So that, commercial products from Montena, Panasonic, Siemens or Epcos are already available.

Power improvement of such devices is mainly dependant of the internal impedance lowering. A previous communication has presented that one of key points is to enhance the current collector/active material interface and that is realized by a carbonaceous interlayer.

An other way to increase supercapacitor carbon electrode power is to mix Multi-Wall-Carbon-NanoTubes with activated carbon in order to improve both ionic and electronic percolation network of the active material. So that the equivalent series resistance is greatly decreased (figure 1), and the time constant of the supercapacitor [1] so does (figure 2): the more de MWCNT content, the more the power.

A 15 % weight ratio of MWCNTs in active material is demonstrated to be the best compromise; beyond this value the capacitance is too much decreased (figure 3). Supercapacitors using a 15%wt MWCNT active material exhibit, in galvanostatic charge-discharge, a very good stability of the ESR for more than 10,000 cycles (figure 4). Performances obtained are 93 F/g and 0.6 Ω.cm² for respectively specific capacitance of active material and equivalent series resistance.

Adding MWNTC in active material, power electrodes for supercapacitors are then realized leading to a specific power of 62 kW/kg and a specific energy of 17 Wh/kg of active material for the supercapacitor cell.

[1] *P.-L. Taberna, P. Simon, J.F. Fauvarque, Journal of the Electrochemical Society, 150 (3) A292-A300 (2003).*

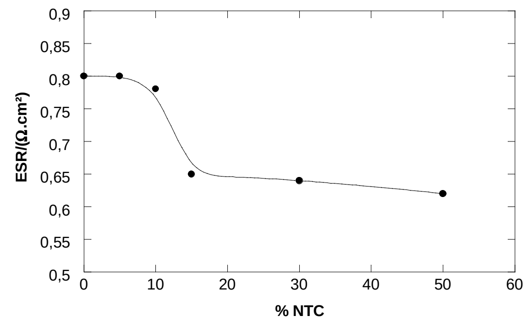

Figure 1: *Change of the ESR with the MWCNT content in the active material.*

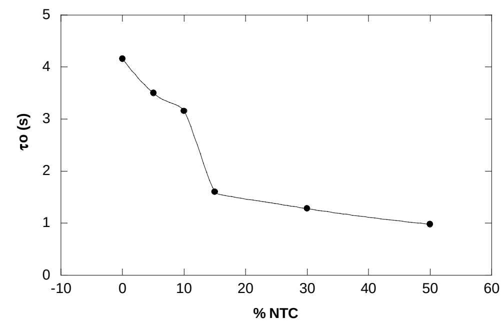

Figure 2: *Change of the relaxation time with the CNTs weight content in the active material.*

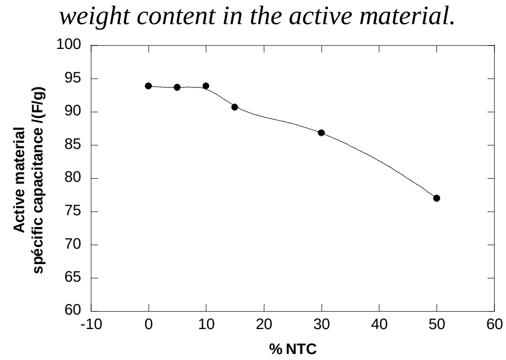

Figure 3: *: Change of the active material specific capacitance with the MWCNT amount in the active material during cycling experiments at 20 mA/cm² between 0 and 2.3V.*

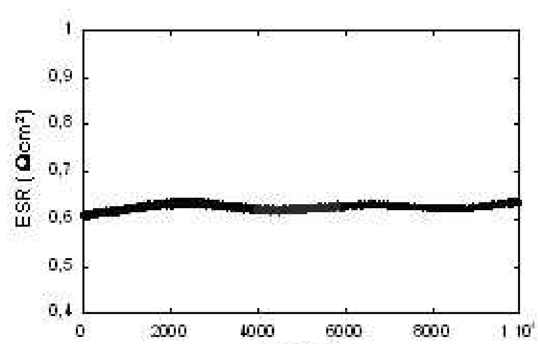

Figure 4: *Change of the ESR for a supercapacitor cycled between 0 and 2.3V at a constant current of 100 mA/cm² ; active material composition : 80% activated carbon, 15% CNTs, 5% binder.*