Hybrid Supercapacitors – From Laboratory to Industrial Development

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Supercapacitors are promising devices for energy storage because their characteristics are between these of dielectric capacitors and those of conventional batteries. Three different main types of supercapacitors are described in the literature : carbon/carbon [1], metal oxide [2], and electronically conducting polymers [3-5] systems. Nowadays, new types of hybrid supercapacitors are studied, to improve the performances of these systems [6-8].

The work presented is the result of a four years collaboration between european university laboratories and industrials (within project n° JOE3-CT97-0047 of the European Commission), to optimise a new type of hybrid supercapacitors with a conductive polymer as positive electrode and an activated carbon as negative electrode.

The conductive polymer chosen was the poly-3-methylthiophene (pMeT), electrochemically synthezised under powder form. The active materials were processed into composite electrodes with 5% binders (CMC-PTFE).

Figure 1 presents pMeT p-doping. The capacity obtained was 50 mAh/g with a coulombic efficiency over 99%. The galvanostatic cycling of the cell is presented on **Figure 2**. The polymer p-doping domain was strictly respected to avoid polymer degradation, meanwhile the quantity of activated carbon was adjusted to obtain the maximum cell voltage. The optimised cell cycles between 0.8V and 3V. pMeT proved 270 F/g and the Picactif SC 105 F/g. The cell reached a specific maximum energy of 45 Wh/kg of active layer (active materials + conducting additives + binders), and the maximum power reached was 35 kW/kg. These performances were maintained with less than 20% of loss over 1000 cycles.

The system was developped at industrial level with 2×25 electrodes prototypes. The binder technology allowed to co-laminate the active materials on the aluminium current collectors.

The main characteristics and performances are resumed in **Table 1**. The capacity obtained was around 1500 F for 389 g modules. The maximum energy obtained was 5Wh/kg of total module for a maximum power of 2 kW/kg.

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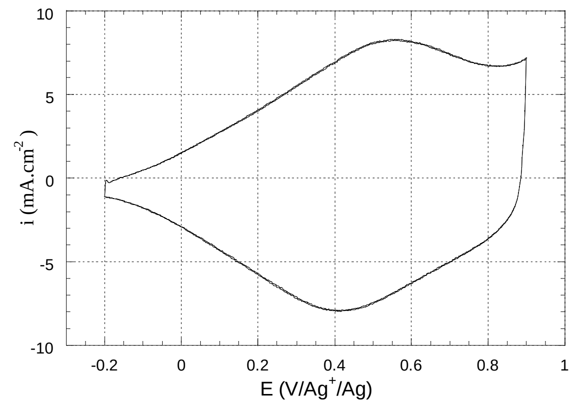

Figure 1 : Cyclic voltammetry of pMeT at 20 mV/s.

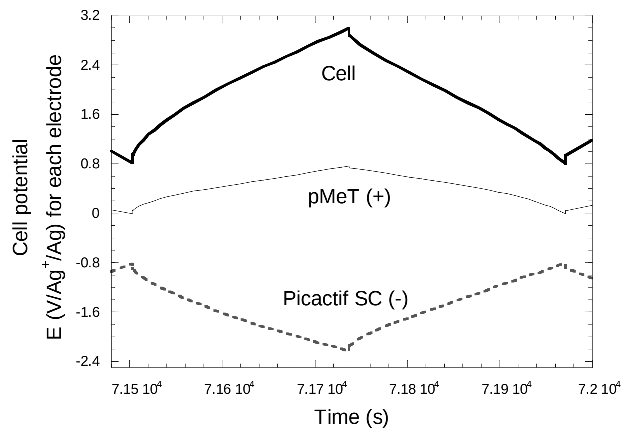

Figure 2 : Galvanostatic cycle of a pMeT//Picactif SC supercapacitor cell.

Prototype Picactif SC / PMeT
Electrode surface : 60 cm^2 / electrode Positive : 80% pMeT, 15% acetylene black, 5% binders, Negative : 95% Picactif SC, 5% binders Separator : 2x25µm PTFE Collectors : treated aluminum Electrolyte : NEt_4BF_4 1M in PC Weight : 389 g
Performances (Total weight of the prototype)
Cell voltage : 3V Capacitance : 1500 F Resistance : 3.1 mΩ Specific energy (3 V): 5 Wh/kg Specific power (3 V) : 2 kW/kg

Table 1 : caracteristics and performances of an industrial prototype pMeT//Picacatif SC.

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