Ion confinement in carbon nanopores - application to supercapacitors

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Abstract
This presentation will focus on different approaches for improving the energy density of electrochemical Capacitors. In a first step, we will show by electrochemical measurements how the control of the porous structure (pore size) of microporous carbons can greatly enhance their gravimetric capacitance. The basic mechanism of this capacitance enhancement will be explained thanks to recent results obtained by atomistic modeling [1], whose results were recently confirmed back by electrochemical experiments.

In a second step, we will present results about the characterization of new electrolytes based on eutectic mixtures of ionic liquids, for widening the operation temperature range and the single cell voltage. High voltage window up to 3.7V at room T were obtained, thus increasing the energy density. Operation temperature down to -50°C were found to be possible thanks to the unique feature of the IL eutectic mixture that stays liquid at these temperature [2]. Modifying the carbon / electrolyte interface by selecting carbon with highly accessible surface area. Such approach is seems promising for designing electrochemical capacitors with large temperature range and high voltage.

References:
[1] C. Merlet, B. Rotenberg, P.A. Madden, P.-L.Taberna, P. Simon, Y. Gogotsi, and M. Salanne, Nature Materials 11 (2012) 306-310.

[2] R. Lin, P.-L. Taberna, S. Fantini, V. Presser, C. R. Pérez, F. Malbosc, N. .L. Rupesinghe, K. B.K. Teo,[¶] Y. Gogotsi and P. Simon, Journal of Chemistry and Physical Letters 19 (2011) 2396-2401

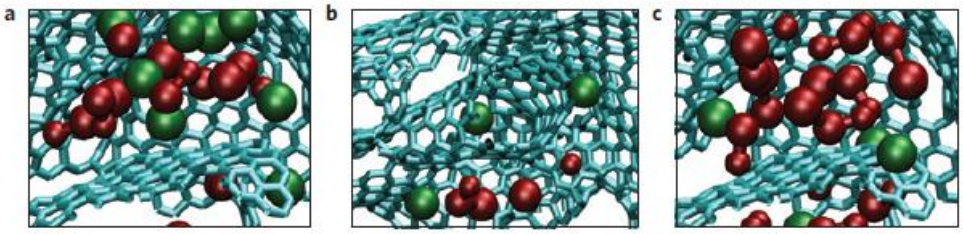

Fig. 1. Structure of the BMI,PF6 ionic liquid inside electrified pores of microporous carbons; from [1].

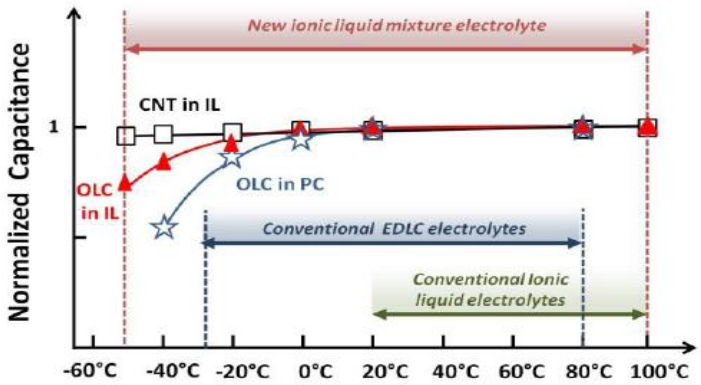

Figure 2: Normalized capacitance (C/C20°C) for the different carbon electrodes in (PIP13FSI)0.5(PYR14FSI)0.5 ionic liquid mixture and PC + 1 M TEA-BF4 electrolytes. From [2].