Contribution ID: **33** Type: **Oral**

Ionic Liquids: bulk vs 1D CNT confinement. Towards better batteries?

Wednesday, 14 September 2022 12:00 (35 minutes)

composite polymer membranes made out of vertically aligned carbon nanotube (CNT) forests. As this system shows no tortuosity and no friction at the electrolyte / CNT interface, the transport properties within the pore system (the interior of the CNTs) are expected to be tremendously enhanced. We actually have recently shown1 that, compared to the bulk situation, such 1D CNT nanometric confinement induces a conductivity gain of the electrolyte as high as 50. We interpret this result as a possible revelation of a superlubricity phenomenon under confinement2. Such 1D CNT membrane making possible an ultra-fast travel of the ions in between the electrodes of a battery separator is an appealing route to boost the power density of batteries (Fig. 1). A patent has been filed3.
In this framework, a thorough multiscale characterization of the confined electrolyte is essential. The competition between electrostatic and van der Waals interactions leads to a property original for pure ILs: they self-organize in fluctuating nanometric aggregates. So far, this transient structuration has escaped direct clear-cut experimental assessment. In bulk, we have taken advantage of the alliance of QENS (Tof and NSE), PFG-NMR and particle-probe rheology to i) catch this phenomenon and ii) highlight an unexpected consequence: a one order of magnitude difference of the transport quantities, depending whether they are inferred at the molecular or at the micrometric scale4. Along with electrochemical impedance spectroscopy data, we will also show Tof and PFG-NMR measurements of the same IL confined in the CNT membranes.

1. Berrod, Q. et al. Ionic liquids confined in 1D CNT membranes:gigantic ionic conductivity. ArXiv171006020 Cond-Mat (2017).
2. Heiranian, M. & Aluru, N. R. Nanofluidic Transport Theory with Enhancement Factors Approaching One. Acs Nano 14, 272–281 (2020).
3. Berrod, Q., Ferdeghini, F., Judeinstein, P. & Zanotti, J.-M. Nanocomposite membranes for electrochemical devices. Patent WO
2016151142 A1. (2016).
4. Berrod, Q. et al. Ionic Liquids: evidence of the viscosity scale-dependence. Sci. Rep. 7, (2017).

E-mail for corresponding author: jmzanotti@cea.fr

Primary authors: Dr PINCHART, C (LLB / Univ Paris-Saclay, UGA, CEA, LITEN, Grenoble, France); Dr GIGMES, D. (Institut de Chimie Radicalaire, Marseille, France); ZANOTTI, Jean-Marc (Laboratoire Léon Brillouin (CEA-CNRS), Université Paris-Saclay, Gif-sur-Yvette, France); Dr MODESTO, N. (LLB, UGA, Institut de Chimie Radicalaire, Marseille, France); Dr JUDEINSTEIN, P. (LLB, Laboratoire de Physique des Solides, CNRS/Université Paris-Saclay, Orsay, France); Dr BERROD, Q. (IRIG/SyMMES/STEP, Grenoble, France); RAMOS, R. (Université Grenoble-Alpes, CEA, LITEN, Grenoble, France); Dr PHAN, T. (Institut de Chimie Radicalaire, Marseille, France)

Presenter: ZANOTTI, Jean-Marc (Laboratoire Léon Brillouin (CEA-CNRS), Université Paris-Saclay, Gif-sur-Yvette, France)

Session Classification: Session 4 : Batteries & ionic conductors