A one-step route to solid-state devices with ionic liquids properties.

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Abstract

Ionic liquids (ILs) are currently the focus of a rapidly growing number of studies in materials science, for instance for lithium batteries, supercapacitors, solar and fuel cells. Besides the goal of taking advantage of the properties of ILs in materials, their liquid nature limits their use due to shaping necessities in most devices, possible leakages, miniaturisation impediments. Thus, regardless of the pursued application, taking advantage of ILs properties in solid-state materials remains a major challenge. To this aim, several approaches are under investigation through grafting on supports, swelling in polymers, impregnation on preliminary prepared oxide particles.

For the last few years, we have focused our interest on another route, an original sol–gel approach carried out in ILs that leads to the nanoconfinement of ILs in an open mesoporous oxide network, so-called ionogels.

It will be shown here that these solid materials present ILs properties such as high ionic conductivity and liquid-like efficient chromophore solvation within a monolith. Specific application to lithium batteries will be developed. A further in depth study will show that at this level of confinement, the dynamics of the confined IL remain highly similar to that of pristine IL, using spectroscopies (PGSE, relaxometry, QENS) giving dynamics information at time and space scales from approximately the *ns* to the *ms* and from the *nm* to the *µm*.