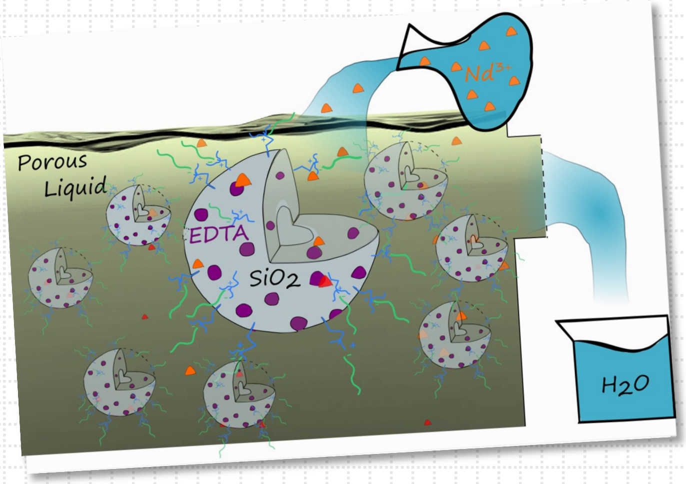
PhD DEFENSE



Hydrophobic porous liquids: design, synthesis, and evaluation for metal extraction

Lorianne GINOT

Ion Separation using self-assembled Molecular systems (LTSM)

NOV 4

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2:00 PM

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Porous liquids (PLs) are a recent concept suggesting that porosity can exist in the liquid state: they contain porous hosts initially solid, which are either dispersed in a solvent or turned into a liquid by physicochemical post-treatments. In literature, most studies focus on applying this concept to the capture and storage of gas. However, some PLs like the hybrid ones based on organic moieties tethered on inorganic hollow silica particles contain pores of nanometric size, and this PhD thesis aims to investigate their potential for an application in metal liquid-liquid extraction (LLE). Since metals are usually found in aqueous leachates after ore treatment, the extracting phase must be hydrophobic, to separate the phases after metal capture. Therefore, the first challenge consisted of adapting the methods from the literature to synthesize silica-based PLs with an adjustable affinity toward the water. This was achieved by varying the nature of the organic canopy (ionic or neutral; amphiphilic or purely hydrophobic). By varying the nature of the silica core as well, the porosity and viscosity of PLs could also be tuned. In particular, it was found that an adequate organic: inorganic weight ratio was necessary to obtain a liquid with satisfying fluidity. As the permeability of PLs to aqueous phases is essential for LLE, a method based on small-angle neutron scattering was developed to confirm that silica-based PLs are indeed permeable. Finally, the correct functionalization of PLs allowed their application to the extraction of three rare earth elements from nitrate leachate, with extraction capacities in the same order of magnitude as what was found in the literature for solid sorbents. Encouraging sorption results have been obtained, opening up numerous opportunities for optimization in the application of PLs in LLE.

Keywords: Molybdenum; UO_2-based model compounds; Dissolution mechanisms; Solid-liquid interface; Nuclear fuel recycling

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