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NMR study of the molecular dynamics in magnetic and non-magnetic ionic liquids

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Recent studies [1-2] have proven the existence of superparamagnetic properties associated with mixtures comprising magnetic ionic liquids (MILs) (based on either $[Aliquat]^+$ or $[P_{66614}]^+$ cations and on a $[FeCl_4]^-$ anionic complex) and their analogous ionic liquids (respectively [Aliquat][Cl] and $[P_{66614}][Cl]$). In both these cases, only 1% of the mixture was composed of metal ions and yet, an electronic spin of the order of 100 is observed. These properties were, however, destroyed when the same amount of phosphonium-based MIL was dissolved in dimethyl sulfoxide (DMSO), possibly because this solvent is not as structured as an ionic liquid and, therefore, does not allow for a coupling of the iron spins.

In order to identify the physical properties that are at the origin of this superparamagnetic behavior, the same [Aliquat]-based magnetic and non-magnetic ionic liquids mixed with smaller amounts of DMSO and having the same concentration of magnetic particles were studied using NMR techniques (relaxometry and diffusometry) and viscometry.

To study the effect of a different metal ion in the superparamagnetic properties, $[P_{66614}]^+$ was associated with different concentrations of a gadolinium anionic complex, $[GdCl_6]^{3-}$, instead of the reported iron-based one, and mixed with $[P_{66614}][Cl]$.

NMR relaxometry and diffusometry were also performed at different temperatures.

[1] *J. Phys. Chem. B*, **2013**, *117* (39), pp 11877–11884

[2] *J. Phys. Chem. B*, **2015**, *119* (35), pp 11740–11747