Ionic Liquids: versatility and potential as interfacial agents for designing physicochemical interactions and tailoring morphology and properties of nanofilled polymers.

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The design of nanostructured polymers is an important issue for the use of polymer-based materials in high-value industrial applications. Among these polymer-based nanomaterials, the design of an inorganic-rich nanostructure could be a relevant solution allowing the combination of properties of both organic and inorganic components as well as the unexpected properties of matter at nanoscale.

Interfaces and resulting interphases are key components for many multifunctional materials and even more particularly for nanomaterials such as nanocomposites according to the large amount of deployed surface of contact in between phases due to nanosize objects. Very recently, Ionic liquids (ILs) are become attractive additives as interfacial agents thanks to their excellent physico-chemical properties such as low volatility, non-flammability, good ionic conductivity, excellent thermal stability as well as their ability to tune their affinity towards the polymer matrix by the control of the chemical nature of the counter-anion and/or the cation. Such interactions involve a wide variety of bonding mechanisms and energies resulting in organic-inorganic materials of variable stability and reactivity.

The lecture will describe different routes proposed to design the interphase and will underline i/ the role of the design of the molecular architecture of ILs in order to control the polymer-IL-nanofillers interactions and *ii/* the needs of proper physico-chemical characterization techniques to investigate the fundamental mechanisms and to analyze the resulting nanostructures in order to establish microstructure-properties relationships.

Several examples of ionic liquids modified nanofillers-polymer combinations will be detailed to design polymer nanomaterials from : i) layered silicates involving electrostatic interactions with ammonium, phosphonium, or imidazolium-based ionic liquids , ii) colloidal silica particles on which covalent bonds are possible through the use of silylated ionic liquids or iii) only Π–Π intermolecular interactions between graphene and ionic liquid. A last route will be described from the introduction of metal-oxo clusters, such as organo-functional polyhedralsilsesquioxanes modified by ionic liquids to lead O/I networks synthesized under thermal conditions or UV exposure.

[1] Livi, S.; Gérard, J.F.; Duchet-Rumeau, J. Chapter 24: in Ionic Liquid-Based Surfactant Science (eds B. K. Paul and S. P. Moulik), John Wiley & Sons, Inc, Hoboken, NJ, 503-517, DOI: 10.1002/9781118854501.ch24, (2015).