Ionic Liquids: A powerful Toolbox for the design of multifonctional polymer materials

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Nowadays, advanced polymer materials are at the forefront of tackling global challenges such as environmental issues while pursuing research into high-performance materials. Thus, the development of new synthetic methods is critical for designing innovative polymer materials and proposing sustainable solutions to meet the requirements of the circular economy, *i.e.* to be sustainable, reusable, and recyclable. Scientists must thus propose through a *'Functional materials by design'* approach to develop molecular brick platforms or additives allowing the integration at the molecular scale of the required functions in the initial synthesis steps. Simultaneously, scientists must think to the End-of-Life of these functional materials by the concept *'design to recycle' or 'design to degrade'* , to be reused in a closed loop supply chain. In fact, the unique properties of ionic liquids (ILs), such as their high thermal stability, low vapor pressure, non-flammability, and hydrophobic behaviour make them promising candidates for the development of a new generation of polymer materials with enhanced properties [1-4] as well as solvents greening the chemical recycling of thermoplastics. Recently, our laboratory has designed a new generation of more environmentally friendly, i.e. reusable and/or degradable epoxy-amine and epoxy-anhydride networks by using ILs leading to networks with Tg included between 60 °C to 200 °C combining good thermomechanical and mechanical properties. In other side, ionic liquid and a deep eutectic solvent (DES) were used to compatibilize polymer blends based on PBSA/PHB (80/20). Thus, we have demonstrated that the addition of a small amount of these interfacial agents simultaneously led to a considerable improvement in the mechanical performances of the blends. In terms of thermal stability, the use of ILs and DES stabilized the PBSA/PHB blend and retarded its thermal degradation (+ 100 °C), Moreover, the oxygen and water permeability were also investigated confirming that the synergistic effect of these additives with the PHB inducing a significant reduction in permeability and increasing the degradability of the corresponding polymer blends. In summary, Ionic Liquids are a promising additives to design fnctional polymer materials with high performances.

Keywords: Ionic Lquids, Degradable networks, Polymer blends, Chemical recycling

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