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Design of nanocomposites by interfacing biopolymers with metal oxides and metal organic frameworks (MOFs)

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Biopolymer-based materials have received increasing attention for potential applications in energy, medicine and environment domains. The main advantage of using macromolecules of natural origin is related to their chemical complexity and self-assembly properties, for which no synthetic equivalent is usually available, together with their large abundance and non-fossil origin, two key aspects for the synthesis of green materials. The development of bio-elastomers usually requires their reinforcement by appropriate fillers that enhance the mechanical properties and impart new physico-chemical properties (catalytic, optical, magnetic, gas separation, etc.). In this presentation, we will focus on functional nanocomposites prepared by assembling biopolymers with different types of inorganic fillers including metal oxides, polyoxometalates and metal organic frameworks. First, by combining gelatin with a large range of polyoxometalates of different charge density, bio-elastomers with tunable mechanical properties were prepared by a complex coacervation process. Due to cost-effectiveness, ease of preparation and biocompatibility, these nanocomposites may present great potential as modified electrodes for detection as well as drug carriers or scaffolds for tissue engineering. More recently, our interest was also devoted on composite membranes prepared by combining porous metal polycarboxylate based MOFs and biopolymers for gas separation application. An approach integrating advanced characterization tools was developed at the colloidal level to characterize the microstructural and physico-chemical properties of these materials. Indeed, one critical issue of this family of materials concerns the chemical and thermodynamic compatibility between polymers and inorganic particles that drive both the polymer microstructure (degree of crystallinity, cross-link/entanglement density, confinement effect, etc.) and the dispersion of nanofillers.

Biography

Nathalie Steunou is a Professor at the Institute of Lavoisier from the University of Versailles St Quentin-en-Yvelines-Université Paris Saclay, France since 2010. She was an Assistant Professor for about 11 years at the Pierre-and-Marie-Curie University in the Laboratory Chimie de la Matière Condensée de Paris. She has acquired a strong expertise in the Chemistry of Hybrid Materials based on metal oxides, metal organic frameworks and biopolymers for different applications in the domains of energy, environment and medicine. She is co-author of more than 60 papers.

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