Sinchem 2016 doctoral research subject

Polysaccharide encapsulated catalysts: towards the sustainable production of fine chemicals

HOME INSTITUTION: Ecole Nationale Supérieure de Chimie de Montpellier (ENSCM), Institut Charles Gerhardt, Montpellier, France; supervisors: Dr. Nathalie Tanchoux and Dr. Françoise Quignard

HOST INSTITUTION 1: University of Bologna, Italy; supervisor: Prof. Luca Bernardi

HOST INSTITUTION 2: to be defined

PROJECT DETAILS: In the last years, heterogeneous catalysis based on natural polysaccharides is beginning to emerge. Compared to traditional oil-based polymeric materials (e.g. polystyrene), the attractiveness of the applications of polysaccharides in catalysis stems from both their availability from renewable resources and their intrinsic properties.

Marine Polysaccharides naturally bear functional groups that have to be inserted by energy-consuming operations in oil-derived polymers. For instance, chitosan brings basic functions, while alginate and carrageenan are acidic polymers. These functional groups provide polysaccharides with a surface reactivity very appealing for specific adsorption/binding processes. Polysaccharides gels display viscoelastic mechanical properties which, coupled to their easy formation in different shapes and sizes, contribute to an excellent accessibility of the active sites.

The aim of this PhD project will be to prepare and characterize new tailored materials featuring different shapes, porosity, mechanical and surface properties starting from natural polysaccharides, and to evaluate their applicability in the frame of catalytic processes of crucial importance for the manufacturing of enantio-enriched building blocks for fine chemicals. Metal-, organic- and photo- catalysis will be investigated, according to two approaches: i) catalyst encapsulation in the polysaccharide matrix through non-covalent interactions; ii) end-process recovery of a homogeneous/organic catalyst via its selective encapsulation in the polysaccharide, and subsequent stimulus-induced release enabling its reuse. The latter approach not only provides a simple platform for catalyst recovery and reuse, it will allow some (semi-)continuous process to be possible with organic catalyst. On the other hand, catalyst heterogeneization through encapsulation is potentially able to bring additional benefits such as improved kinetics and/or selectivity.

The PhD student will gain experience in the preparation and characterisation of dispersed materials, adsorption kinetics, organic synthesis, (asymmetric) catalysis. She/he will spend 21 months in Montpellier, 12 months in Bologna, and 3 months in a second host institution.