Functionalization of elastomeric structured catalytic supports for the intensification of catalytic processes

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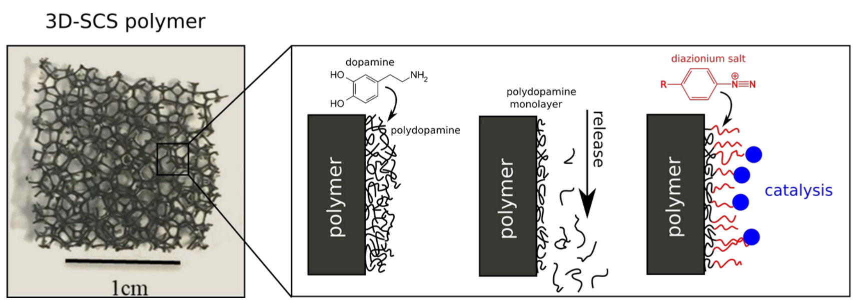
Continuous fixed bed reactors are frequently used in the chemical industry for multiphase reactions. They allow to improve the control of the reaction conditions in order to maximize the conversions and the yields but also to overcome the separation stages between the catalyst and the products [1]. These processes use structured catalytic supports (SCS) in order to have a high specific surface, an efficient mixing of the reactants while limiting the pressure drops. Among the variety of SCS, the use of open cell polymeric foams (e.g. PU foam, melamine…) are prime candidates, fulfilling all these characteristics [2]. In addition, these new elastomeric SCS enable the use of in-situ controlled deformation within the reactor, thus intensifying the transfer of materials thanks to an.



The scientific challenges consist in: (i) to perform a robust functionalization of these SCS-elastomers without modifying their elastic properties and, (ii) to implement them in a dedicated reactor. Within the framework of this PhD, the adhesion of the catalyst on these new SCS-elastomers will be achieved using two versatile and complementary techniques: (i) using polydopamine, a bio-inspired polymer with remarkable properties of adhesion and (ii) from diazonium salts which lead to the formation of covalently grafted polymers films. Polydopamine coating allow a very good adhesion on any type of support [3] but show leaching problems, whereas the grafting by diazonium salts would make it possible to have functional groups bound in a covalent way but must be adapt for each type of support [4]. The objective is to combine the two methods to benefit from the advantages of both (PDA adhesion and diazonium covalent grafting). The release of the PDA mainly concerns the outer layers, which are less strongly bound together than is the initial monolayer in contanct with the substrate. After release of th ePDA coating, a very adherent monolayer of PDA is obtained which can be used as a support for grafting with diazonium salts allowing the introduction of numerous functionalities (see figure above). This method can thus be adapted to the many elastomeric materials available for different multiphase catalysis reactions (hydrogenation/oxidation). Thanks to the approach proposed in this PhD, the catalyst can be either in the form of nanoparticles (Ag, Au), or organic (metal complexes) and therefore covalently grafted onto the film. The second objective of this PhD consists in using the elastic properties of functionalized SCS-elastomers in a new type of innovative reactor currently being developed within the MMAGIC team (the crankshaft piston reactor) [5]. A detailed characterization (in the process engineering sense) of the processes will be carried out and the prepared SCS will be tested for the targeted applications. The success of this transversal project will be facilitated by the combination of complementary skills from the two teams recently merged within the CP2M Laboratory (polymer surface functionalization for the PolyCatMat team and reactor design/process engineering for the MMAGIC team) .

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[2] (a) E. Pardieu, et al , *Chem. Commun.* 2016, *52*, 4691. (b) L. Lefebvre et al . *Environ. Chem. Eng*. 2017, *5*, 79. (c) A. Ait Khouya, et al , *Chem. Commun*. 2019, *55*, 11960.

[3] Lee *et al.* (2007) *Science*, 318, 426-430

[4] Mohamed *et al.* (2015). *Adv. Colloid Interface Sci.*, *225*, 16-36.

[5] Thèse de Laura Birba (ANR POLYCATPUF)