**Wassim Sebai**

Supervisors: Jose Sanchez-Marcano, Marie-Pierre Belleville

# Decontamination of water containing micropollutants by laccase immobilized in silica monoliths

Laccases from *Trametes versicolor* are multicopper oxidases and are efficient to degrade some refractant micropollutants like tetracycline (TC), or bisphenol A from water. Laccases grafted on ceramic membranes have been reported to degrade TC from model solutions [1]. However, the process efficieny is limited by the low capacity of enzyme immobilization of these supports. Silica monoliths with hierarchical porosity and high surface area are very interesting supports to improve the concentration of immobilized enzymes. These monoliths were obtained via a combination of sol-gel process and spinodal decomposition [2].

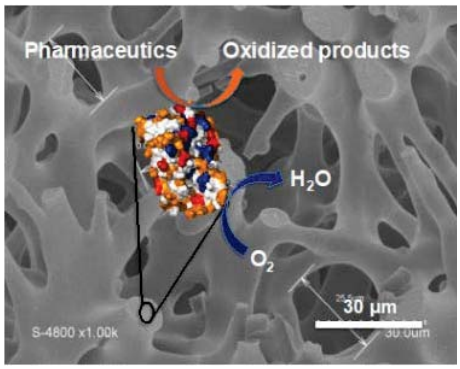


**Figure 1**: SEM image of the macropore struc-ture of silica monoliths and schematic representation of laccase immobilized in the mesopores with an illustration of the oxidation mechanism of micropollutants.

Silica monoliths with uniform and interconnected macropores of 20 µm and mesopores of 20 nm (surface area of 319 $m^2/g$) have been chosen to immobilize laccases (Figure 1). Covalent immobilization was carried out by the successive reaction of silica monoliths with an aminopropylsilane and coupling with glutaraldehyde. The monoliths were used to build tubular bioreactors and tested for ABTS oxidation at pH 4 and TC degradation at pH 7 in batch and also in continuous flow configuration. Kinetic parameters with free and immobilized laccases were calculated for ABTS and TC oxidation. TC solutions were flowed through the enzyme functionalized-monoliths with a flow rate of 1 mL/min with continuous recycling. First results showed that these active monoliths are able to degrade 40-55 % of TC (solution of 20 $mg.L^{-1}$) in 10 h at pH 7 and room temperature. This study shows that this new kind of bioreactors are promising candidates for the depollution of wastewaters.

[1] de Cazes, M., Belleville, M.-P., Petit, E., Llorca, M., Rodríguez-Mozaz, S., de Gunzburg, J., Barceló, D., Sanchez-Marcano, J.(2014). *Catalysis Today*, 236, 146-152.

[2] Galarneau, A., Sachse, A., Said, B., Pelisson, C.-H., Boscaro, P., Brun, N., et al. (2016). *Comptes Rendus Chimie*, 19 (1-2), 231-247.