**MASTER DE CHIMIE DE PARIS CENTRE - M2S2**
**Proposition de stage 2020-2021**
**Internship Proposal 2020-2021**

**Parcours type(s) / *Specialty(ies) :***

☐ Chimie Analytique, Physique et Théorique */ Analytical, Physical and Theoretical Chemistry* :
☐ Chimie Moléculaire / *Molecular Chemistry* :
☐ Chimie et Sciences Du Vivant / *Chemistry and Life Sciences* :
X Chimie des Matériaux / *Materials Chemistry:*
X Ingénierie Chimique / *Chemical Engineering:*

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Période de stage / *Internship period* * : 25 janvier au 25 juin 2021

# Synthesis and characterization of porous materials with catalytic and magnetic properties for depolymerization processes

***Scientific Project :***

**1. *Description of the project***

Intensification of the processes is an important trend in heterogeneous catalysis. Indeed, it is increasingly expected that a heterogeneous catalyst should bear several active phases capable of working together and that the support should allow the reagents to be pre-concentrated/sorted, or even should facilitate separation at the end of the reaction [1].

From this point of view, the incorporation of an iron oxide such as maghemite, $\gamma$-$Fe_2O_3$, in the matrix of heterogeneous catalysts is of real interest as it is supposed to facilitate separation [2]. This oxide also has the advantage of being able to heat up locally by applying an external magnetic field but, finally, relatively little work exploits this effect in catalysis [3]. This is a priori related to the difficulties

* min. 5 mois à partir du 18 janv 2021 / *min. 5 months not earlier than January, 18th 2021.*
Fin de stage au plus tard le 16/07/2021 ou le 30/09/2021 (dates de validation de diplôme). / *End of internship at the latest July 16, 2021 or Sept. 30, 2021 (dates of graduation).*

encountered in the synthesis of materials containing in close proximity $\gamma$-$Fe_2O_3$, a suitable pore network and one or more adequate reactive functions.

The aim of this project is to **prepare catalysts designed for the acid mediated reductive cleavage of C-C bonds under smooth temperature conditions that would be useful for the upgrading of both synthetic and natural polymer wastes.** Targeted catalysts are core-shell type materials at the centre of which will be maghemite nanoparticles and whose outer surface will be composed of porous aluminosilica with an acidity strength comparable to that of zeolites, but which has to be accessible to macromolecules. The chosen strategy will consist in the deposition of a layer of mesoporous silica alumina around the maghemite nanoparticles and then in the partial conversion of its surface into a zeolite deposit by controlled re-dissolution/precipitation processes in the presence of the zeolite's structure directing agent [4]. Syntheses conditions will have to be optimized in order to get a good compromise between porosity, acidity and response to magnetic field.

If sucessful, the same methodology will be applied to metallic monoliths that are also responsive to magnetic field. In case of problems, another approach consisting in the inclusion of the maghemite particles in the zeolite and in the generation of mesoporosity within the zeolite layer by a controlled alkaline attack will be tested [5].

**2. *Specific techniques or methods***

Hydrothermal syntheses using conventional or microwave heating; $N_2$ physisorption; Dynamic light scattering ; $H_2$ temperature programmed reduction (TPR) ; X-Ray diffraction ; Transmission electron microscopy ; Acidity quantification with FTIR ; Magnetic measurements.

**3. *References***

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[2] T.M. Lima, C.G.S. Lima, A.K. Rathi, M.B. Gawande, J. Tucek, E.A. Urquieta-González, R. Zbořil, M.W. Paixão, R.S. Varma, *Green Chem.*, **2016**, 18, 5586.

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