# Synthesis and Characterization of porous silica for a functionalization by plasma polymerization

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Porous silicas are largely studied for their possible use in different fields of applications [1]. The soft chemistry's synthesis conditions used to prepare them, have the advantage of being able to control the morphology and the pore size. These materials are hydrophilic thanks to the presence of silanol groups on their surface. These groups are very reactive and make the grafting of organic functions possible in order to modify the silicas's surface properties (polarity) or in the mass (optical, catalytic, etc). The organic groups can also be complexing agents for the trapping of metal cations, organic molecules etc. Generally, functionalization is carried out by coupling the silanol groups surface with organo alkoxysilanes. The resulting properties depend strongly on the grafting rate and the location of the grafting groups. They are usually carried out in an anhydrous solvent medium (toluene) and require time-consuming multi-step processes. The development of novel rapid and inexpensive functionalization processes is sought-after.

This subject takes place in this context, in order to develop a new strategy of functionalization of porous silicas assisted by plasma polymerization.

The main objectives of this project are the synthesis of silica with controlled morphology and porosity and the organic functionalization of their surface i.e. by plasma polymerization. It will be necessary to develop silica particles of controlled morphology (spherical and monodisperse in size 0.1 to 100 µm) which will serve as model objects to study the feasibility of deposition of organic functions on their surface by plasma polymerization. The challenge here is to obtain a homogeneous deposit on a powdery material. The axes *Ingénie des Polymères Fonctionnels* (IPF) and *Matériaux à Porosité Contrôlée* of the Institute developed a rotating plasma reactor to meet this new challenge.

It will be necessary to optimize the external parameters of the plasma (applied voltage, gas flow rate, exposure time, speed of rotation of the chamber, etc.) in order to obtain a homogeneous deposition on the surface of the silica particles. One of the critical points will be to identify the nature and evaluate the stability of the bonds between the organic groups and the surface of the silica. The materials obtained after plasma treatment will then be treated at high temperature in gas and aqueous phases in order to evaluate their stability, respectively, thermal and hydrothermal. They will also be placed in solution in various solvents to check the stability of the anchor in solution.

Finally, a possible application to this project could be the surface functionalization of biomaterials for various applications such as immobilization of enzymes, adhesion and cell proliferation ...

[1] J.Y. Ying, C.P. Mehnert and M.S. Wong, Angew. Chem. Int. Ed. **38**, 56 (1999), E. Serra, E. Diez, I. Diaz and R.M. Blanco, Microp. Mesop. Mater. **132**, 487 (2010), R. Mellaerts, C.A. Aerts, J. van Humbeeck, P. Augustijns, G. Van der Mooter and J.A. Martens, Chem. Commun. **13**, 1375 (2007), S. Almuhamed, N. Khenoussi, M. Bonne, L. Schacher, B. Lebeau, D. Adolphe and J. Brendlé, Eur. Polym. J. **54**, 71 (2014).