Functionalization of MIL-53(Al) by means of ECR plasma treatment: a feasibility study.

R. Jean-Marie-Desiree[1], A. Najah[1], S. Cuynet[1], L. de Poucques[1], G. Marcos[1]

[1] *Institut Jean Lamour, CNRS-Université de Lorraine, Campus Artem, 2 allée André Guinier, 54011 Nancy*

mél: ronny.jean-marie-desiree@univ-lorraine.fr

Metal-Organic Frameworks (MOFs) (figure 1) are an incoming class of materials, which have been extensively studied these last decades. Their high surface-to-volume ratio and low density resulting to be promising materials for many practical and industrial applications, such as gas storage [1].

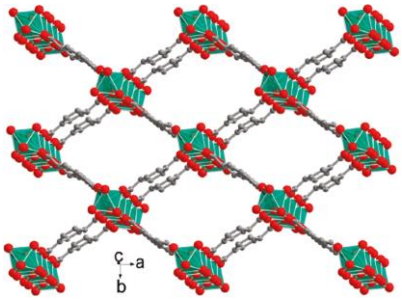

Figure 1 : *Ball-and-stick representations of the 3D framework structure of MIL-53(Al) with Al atoms displayed as octahedra linked by terephthalate organic ligand (color codes: Al, bluish green; C, gray; O, red) [2].*

Among the studies around MOFs, enhancing their sorption performance has been a significant challenge. Indeed, most of the well-known MOFs materials are not usable in realistic and non-ideal environments. A possible solution could be functionalizing MOFs' organic ligands to introduce specific feature depending on the chosen radicals (*i.e.* functional group).

Functionalization methods can be classified in two categories. The first one, called pre-functionalization, consists in chemically bond radicals to organic ligands right before MOFs synthesis [2]. As for the second one, called post-synthesis modification (PSM), this functionalization step occurs after MOFs synthesis [3]. The latter is a general, strategic approach due to a greater control of the functionalizing process to maintain the overall stability of the MOFs' initial lattice. While chemical wet methods have been widely carried-out, this study suggests a new route to functionalize by PSM approach: plasma treatments.

In this study, an electron cyclotron resonance (ECR) source has been used to investigate the feasibility to functionalize a MOF called MIL-53(Al) (MIL stands for Material of Institute Lavoisier) by the mean of low-pressure cold N_2-H_2 plasma ($\sim$ 4 Pa).

On the first hand, ECR plasma was diagnosed with optical emission spectroscopy in order to find an optimum condition where the NH per N_2 intensity ratio is the highest. On the other hand, material characterization (FTIR, DRX, EDX) has been done to track the efficiency of NH-functionalization with different treatment conditions.

References

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