Groupe Electrochimie et Couches Minces

Contacts : catherine.henry-de-villeneuve@polytechnique.edu
michel.rosso@polytechnique.edu

Intership proposal

"*Direct growth of MOF layers onto Silicon surfaces*"

MOFs (Metal Organic Frameworks) are porous crystalline solids obtained by assembly of metal ions and organic ligands. These materials have strong potential for numerous applications (fluid storage, catalysis, sensors, electronic devices, etc.) due to their structural properties (pore size and shape) and physicochemical properties, adjustable by the choice of the precursors (metal or ligands). These materials are generally obtained in the form of (nano)microcrystalline powders by synthesis in solution. Their integration as active components in devices is a very active research field. In this context, the realization of thin layers with well controlled properties is a key issue but remains very often a challenge.[1, 2]

Our group is interested in the realization of MOF layers by direct growth on solid surfaces. The systems investigated are Fe (an abundant, inexpensive and non-toxic metal) and carboxylic ligand based MOFs, offering a diversity of structural properties (pore shape and size) and are photo-active.

Studies carried out in the team have shown that it is possible - from the same precursors ($FeCl_3$ and terephthalic acid) - to obtain layers of variable morphology (individual crystallites or dense layers) and the (co)nucleation and growth of different structural phases on silicon surfaces.[3, 4]

Within the frame of an internship, we propose different possible working axis:

i) The exploration of new synthesis methods or post-synthesis treatments allowing for a better control of the structural properties of the layers (morphology, crystallographic orientation, thickness...)

ii) The study of the properties of MOF thin layers by Infrared Spectroscopy (ATR-FTIR)

iii) The study of the mechanisms leading to the selective growth of certain structural phases.

The subject is experimental. It will involve the fabrication of the systems under investigation by synthesis methods in solution, their characterization by surface analysis techniques (Diffraction/reflectivity/X-ray absorption, electron microscopy (SEM), atomic force microscopy (AFM), optical spectroscopies (FTIR, Raman, UV-vis, ellipsometry) available in the laboratory, and data processing.

Candidate profile: Background in physical chemistry of materials, surface characterization techniques, surface science. Strong motivation, good self-organization, rigor, aptitude for experimental work…

Remuneration: YES (legal internship remuneration)

Références : ***[1]*** *A. Bétard and R. A. Fischer, Chemical Reviews, 2012, 112, 1055-1083.* ***[2]*** *I. Stassen, N. Burtch, A. Talin, P. Falcaro, M. Allendorf and R. Ameloot, Chemical Society Reviews, 2017, 46, 3185-3241.* ***[3]*** *H. Yuan, W. Fu, N. Soulmi, C. Serre, N. Steunou, M. Rosso and C. Henry de Villeneuve, Chemistry - An Asian Journal, 2022, 17.* ***[4]*** *W. FU, PhD thesis, Institut Polytechnique de Paris, 2023.*