## Ph.D. subject for application to the doctoral school of chemistry of Lyon

## Photoredox active Metal Organic Frameworks and related thin films for energy applications.

### Keywords:

Porous materials, coordination polymers, chemical synthesis, structural studies, atomic layer deposition (ALD), diffraction, electron microscopy, photocatalysis, electrocatalysis.

### Project positioning:

The photoredox activity is based on the illumination-induced charge separation process. This way, the solar energy can be harvested into either chemical fuels, electricity or heat, corresponding to photocatalysis, photovoltaic and photothermal effects respectively. All these pathways are highly desirable in regard of the pressing environmental problems. In this context, MOFs, that are porous hybrid materials are considered as the future candidates to answer technological challenges. As for every application, the structuring and shaping of materials is essential, and the growth of high-quality MOF thin films is needed to develop technological applications (electrodes, fuel cells, sensors…).

### PhD project:

The work proposed here focuses on the synthesis and development of photoactive and redox active MOFs for applications in photo and electrocatalysis. More precisely, our group has a strong background on the development of porphyrin-based Metal Organic Frameworks, with high chemical stability[1,2] and exceptional activity in photocatalysis, such as overall water splitting photocatalysis under solar illumination[3]. The work will be focused on widening the scope of applications of porphyrin-based MOFs through chemical modification and thin films growth. Especially, implementation of the ALD based techniques both for the modification of MOFs[4] and for the growth of MOFs thin films[5] are very recent methodologies to achieve tailor made, original materials. Furthermore, the use of the ALD and CVD techniques will be explored to pave the way to superlattice architectures. Superlattice growth is a valuable strategy to reach heterojunctions and increase charge separation for photocatalytic applications.

### PhD location and details:

The project is due to start from October 2023 at the Laboratoire des Multimatériaux et Interfaces (LMI), in the Chimie Inorganique Moléculaire et Précurseurs (CIMP) group. It will be linked to international collaborations in place with the Univ. Politecnica de Valencia (catalysis) and University College Cork Ireland (modeling), the candidate will be involved in these collaborations.
The candidate will apply to the doctoral school of chemistry for a Ph.D. contract. Funding is not secured and will depend on the quality of the application and audition.

### Desired candidate's skills:

Hands on experience with chemical synthesis (organic, inorganic, handling of sensitive materials), solid knowledge in structural characterization by X-Ray diffraction and spectroscopic techniques (NMR, IR, UV-vis). Knowledge or experience with CVD, ALD, ellipsometry, electron microscopy, thermal analysis, gas sorption would be an asset. A wide scientific curiosity and good communication skills are required for team work.

### Contact:

For any additional information, please contact us.
Please send your applications (including the CV and masters certificate with grades) to alexandra.fateeva@univ-lyon1.fr and catherine.marichy@univ-lyon1.fr

### References


1. Fateeva, A. *et al.* A Water-Stable Porphyrin-Based Metal–Organic Framework Active for Visible-Light Photocatalysis. *Angew. Chem. Int. Ed.* **51**, 7440–7444 (2012).
2. Mouchaham, G. *et al.* Adaptability of the metal(iii,iv) 1,2,3-trioxobenzene rod secondary building unit for the production of chemically stable and catalytically active MOFs. *Chem. Commun.* **53**, 7661–7664 (2017).
3. Gikonyo, B. *et al.* Mixed-metal Zr/Ti MIL-173 porphyrinic metal-organic frameworks as efficient photocatalysts towards solar-driven overall water splitting. *J. Mater. Chem. A* (2022) doi:10.1039/D2TA06652A.
4. De, S. *et al.* Vapor-Phase Infiltration inside a Microporous Porphyrinic Metal–Organic Framework for Postsynthesis Modification. *Inorg. Chem.* **59**, 10129–10137 (2020).
5. Gikonyo, B. *et al.* Investigating the vapour phase synthesis of copper terephthalate metal organic framework thin films by atomic/molecular layer deposition. *Dalton Trans.* **52**, 211–217 (2023).