ANR funded PhD project

Synthesis and structuration of porous coordination polymers with redox activity for electrocatalysis

In our group we are developing porous coordination polymers also called Metal Organic Frameworks (MOFs) based on redox active ligands. MOFs represent a class of sophisticated nanostructured crystalline solids. They consist of infinite networks of metal clusters or ions coordinated by organic linkers in a 2 or 3D structure. These functional solids display great potential for applications in catalysis. In this research project we are first aiming to synthesise porous MOFs based on redox active ligands such as porphyrins, to electrochemically characterise these solids and to explore their activity in electrocatalysis for small molecules activation (O_2 and CO_2). Incorporation of linkers such as metallopoprhyrins into solid state nanoporous materials with a very high concentration of active sites constitutes a promising approach for applications in energy harvesting and heterogeneous catalysis.

Moreover, we are aiming to explore the very fine structuration of such solids with an innovative approach: use of the Atomic Layer Deposition (ALD) technique. This technique allows for a great advantage to avoid the equilibrated reactions in solution and opens completely new opportunities for MOFs structural controlling.

An important step in this task will be the design and synthesis of redox active ligands with good volatility. First tests will be performed with known sublimable porphyrinic ligands, and then other systems will be considered such as phthalocyanines and dithiolenes.

ALD structuration brings the greatest opportunity to foresee molecular solids based on several redox active linkers combined inside one crystallite in a totally controllable way. This structuration control is for now inexplored therefore this ambitious project opens the path to pioneering structures.

Such materials will be structurally characterized and studied for their potential and properties in electrocatalysis, especially the impact of structuration on the performance will be investigated. This challenging and interdisciplinary project would allow a motivated candidate to explore a particularly large class of techniques.

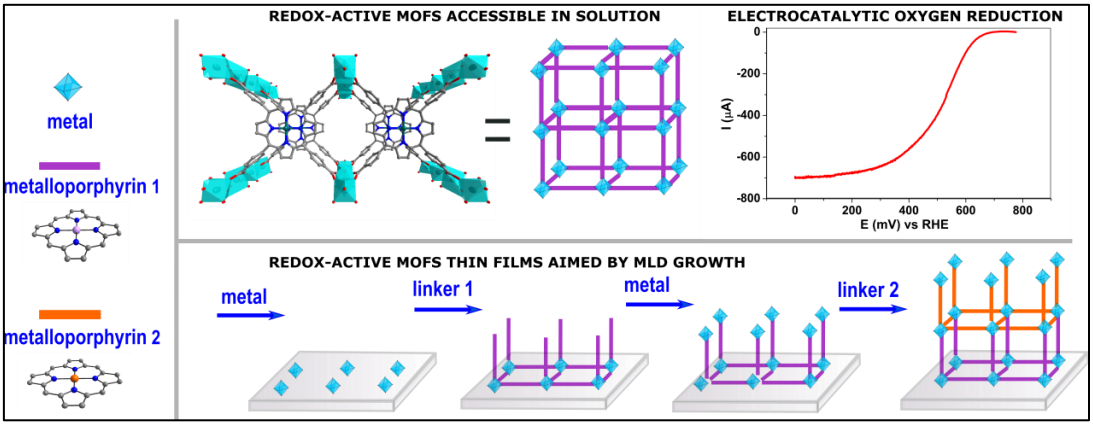

Figure 1: Possible structuration of redox active MOFs by ALD

Techniques:

Organic synthesis, coordination chemistry, solvothermal synthesis, inert atmosphere work, atomic layer deposition. X-ray diffraction (powder and single crystal), spectroscopies (NMR, IR, UV-vis), MS, SEM and TEM, AFM, ellipsometry, sorption isotherms measurements, liquid and solid state electrochemistry

Skills:

Highly motivated candidates careful with research work and having excellent communication and organizational skills are encouraged to apply. Knowledge in coordination chemistry, materials science, experience with chemical synthesis and general scientific interest is highly appreciated.

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