Sujet de stage de Master 2 CDM 2025-26

TITRE

Investigation of the potential of MOF-derived Porous Perovskites

CONTEXTE

Doping of metal oxide systems with an additional metal has been a conclusive approach to improve and expand their performances and the extent of their applications. Recently, a novel approach is being investigated for the synthesis of metal-based systems, metal oxides, and perovskites. Indeed, the synthesis of metal oxide and perovskites by calcination of MOFs (Metal-Organic Frameworks) is gaining interest as a new synthesis pathway leading to porous and stable carbon/metal-based and metal-based systems, with inherited characteristics of the pristine MOF, such as high surface area, composition diversity, and tailored porosity (Fig. 1).[1] MOFs are porous crystalline metal-organic compounds, known for their porosity and organized crystalline structure, and are predominantly used for gas separation and storage, and catalysis. A perovskite resulting from the calcination of a MOF may retain properties from the original MOF and notably its porosity.[2] Additionally, MOFs can contain several metals, which makes it possible to consider the direct synthesis of perovskites from well-designed large specific area MOFs.

OBJECTIFS ET COMPETENCES VISEES

During this internship, the student will first be acquainted with the synthesis of common MOFs. Then, their work will be to explore the possibility to synthesize multi-metallic MOFs through direct synthesis. Secondly, the obtained MOFs will be derived to ABO_3 perovskites through calcination. The obtained materials will be studied through several characterization methods including XRD, FT-IR, (BET) N_2 adsorption isotherms, TGA-DSC, Elemental Analysis, and ICP.

COMPETENCES REQUISES

The student will be expected to be thorough and attentive, as the synthesis of MOFs is highly de-pendent on the synthesis conditions. Solid bases in organic or inorganic chemistry are required, and knowledge related to materials chemistry and their characterization will be appreciated.

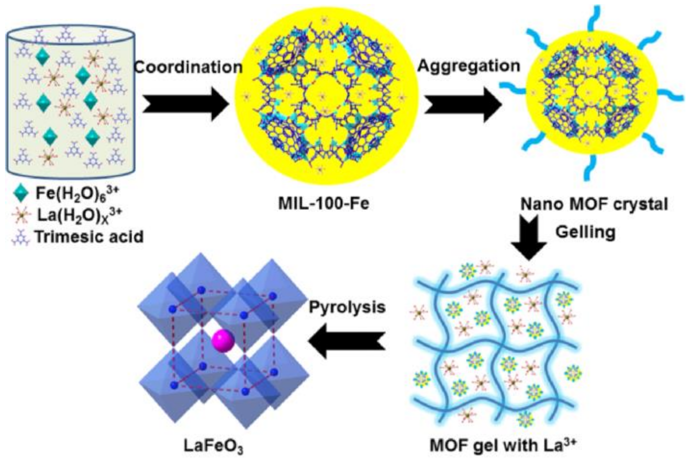

Figure 1. Schematic example of for the synthesis of a MOF-derived perovskite.[3]

References:

[1] J. Zhao, *et al.*, *Controlled porous hollow Co_3O_4 polyhedral nanocages derived from metal-organic frameworks (MOFs) for toluene catalytic oxidation, Molecular Catalysis* **2019**, *463*, 77-86.

[2] A. Shahzad, *et al.*, Harnessing the potential of MOF-derived metal oxide composites to optimize energy efficiency in batteries and supercapacitors, *J. Energy Storage* **2024**, *87*, 111447.

[3] Y. Zhang, *et al.*, Mesoporous $LaFeO_3$ perovskite derived from MOF gel for all-solid-state symmetric supercapacitors, J. Chem. Eng. **2020**, *386*, 124030.

RESPONSABLE(S)

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