COLLÈGE DE FRANCE 1530

SCIENCES SORBONNE UNIVERSITÉ

POSTDOCTORAL RESEARCH POSITION

Functionalized MOFs for the photoelectroreduction of CO_2 and oxidation of water

Faculty: Laboratoire de Chimie des Processus Biologiques (LCPB), Collège de France, PSL Research University, CNRS, Sorbonne Universités

Location : 11 Marcelin Berthelot, 75231 Paris Cedex 05, France

Salary : depending on experience

Tenure : 12 months (start possible from January 2022) with possible extension

Enquiries to C. Mellot-Draznieks, e-mail : caroline.mellot-draznieks@college-de-france.fr

Postdoctoral Position

Functionalized MOFs for the photoelectroreduction of CO_2 and oxidation of water

Position for 12 months – From January 2022 - Financial support: ANR

Collège de France, Paris

In the very active field of CO_2 reduction into valuable chemicals, semiconductors, molecular complexes and metal-organic frameworks (MOFs) have been particularly considered for the photochemical CO_2 reduction reaction (CO_2RR). Importantly, MOFs based on metal clusters (nodes) and photosensitive organic ligands (linkers) which act as antenna upon illumination do not require additional noble metal-based photosensitizers (PSs), such as the largely used $Ru(bpy)_3^{2+}$ for photocatalytic applications.

In the last five years, our team has focused research efforts on MOF-based systems for photocatalytic applications. On the one hand, we have combined a cobalt-polyoxometalate (Co-POM) catalyst and the photosensitive porphyrinic MOF-545 to provide the first noble metal-free heterogeneous photosystem **for water oxidation**: under visible light illumination (*J. Am. Chem. Soc.* **2018**, *140*, 3613; *ACS Appl. Mater. Interfaces*, **2019,** 11, 47837-47845). On the other hand, our group also developed MOF-based materials towards **CO_2RR** using targeted functionalization strategies (*ChemSusChem* **2015**, 8, 603-608; *Angew. Chem. Int. Ed.* **2020**, 59, 5116-5122, *J. Am. Chem. Soc.* **2020**, 142, 20, 9428-9438). We have recently proposed strategies for boosting photocatalytic CO_2RR properties of the porphyrinic MOF-545, while elucidating the unique mechanism at play.

The post-doc position will build on the above recent achievements of our team on MOF functionalized for CO_2 reduction and water oxidation. Porphyrinic MOFs exhibit photocurrent responses reported in the field of photocatalytic oxidation of water (*Chem. Sci.*, 2016, 7, 1070) and reduction of CO_2 (*Angew. Chem. Int. Ed.* 2016, 55, 14310; *Appl. Cat. B: Env.* 2018, 227, 54 8; *Inorg. Chem.* 2020, 59, 6301). **Still the use of MOFs in photoelectrocatalysis is a scarcely explored area.** Photoelectrocatalytic reduction of CO_2 would reduce electricity consumption as compared to the CO_2 electroreduction because of the introduction of solar energy. Moreover, as compared to CO_2 electroreduction, CO_2 photoelectroreduction may achieve higher efficiency because the applied external bias voltage can drive the separation of photogenerated electrons and holes, which is the most crucial step in limiting the photocatalytic efficiency. Indeed, due to their unique optical and electronic features (*Comm. Chem.* 2021, 4, 47), the use of porphyrinic MOF in photoelectrocatalysis is a rapidly growing area as they are capable of being switched from photoanodic to photocathodic by using appropriate redox mediators in the electrolyte (*J. Mater. Chem. A*, 2019, 7, 3046-3053). **Our ambition is to bring the above MOF-545-based catalysts into the realm of photoelectrocatalytic reduction of CO_2 and oxidation of water, making use of our optimized MOF-545-based catalysts, while optimizing the electrodes preparation.**

Collaborations involved : Institut Lavoisier de Versailles (ILV) - Dr. Anne DOLBECQ and Pr. Pierre MIALANE on MOF synthesis and characterization, POM chemistry.

Potential Candidates should have a strong background in electrochemistry and catalysis:

- Expertise in electrochemistry and electrocatalysis is mandatory (PhD in electrocatalysis)
- Know-how in deposition methods and electrode preparation
- Background in MOF chemistry is highly desirable
- Experience in photoelectrocatalysis would appreciated
- Excellent publication record

Personal Skills

- Autonomy and overall lab in-charge involvement,
- Demonstrated ability to work as a member of a team
- Demonstrated ability to work proactively to progress a research project
- Demonstrated ability to organize own workload
- Ability to meet deadlines
- Clear and fluent report writing and oral communication
- Demonstrated ability to take ownership and responsibility for projects
- management of students, ability to supervise and train early stage researchers

Applications: Cover letter, detailed CV and contact information for three references should be sent to Dr. Caroline Mellot-Draznieks (caroline-mellot-draznieks@college-de-france.fr). Interviews will be proposed on reception of these required documents.