



2023 Master internship at University of Gdansk



TITLE : Investigating the role of metal and ionic liquids modification in Metal Organic Frameworks for enhanced CO₂ photoconversion

LAB & PEOPLE

- Name of the hosting lab: Photocatalysis Group (Department of Environmental Technology, Faculty of Chemistry, University of Gdańsk)
- General activities of the lab: nanomaterials synthesis, photocatalysis, materials characterisation
- Website: <https://chemia.ug.edu.pl/wydzial/katedry/katedra-technologiei-srodowiska>
- Number of staff / PhD: 10 staff members, 9 PhD students
- Supervisor name and contact: Adriana Zaleska-Medynska (Prof.), Aleksandra Pieczyńska (PhD), aleksandra.pieczynska@ug.edu.pl

TOPIC OF THE INTERNSHIP

- Scientific context of the internship (max 20 lines)

Global warming has become a major concern worldwide with increasing amount of greenhouse gases, particularly, the concentration of CO₂ in the atmosphere over past decades. The burning of fossil fuels lead to higher CO₂ emissions in the atmosphere, which in turn trap heat and contributes to global warming and climate change. Reduction of CO₂ produces valuable chemicals and fuels like methane, ethane, ethylene, formic acid, carbon monoxide, methanol in presence of light energy sources or applying external voltage energy. Among the different approaches, photocatalytic CO₂ reduction using metal organic framework materials could be a potential approach for CO₂ reduction mainly due to the easy accessibility, heterogeneous nature and mild operating conditions. MOFs are multifunctional porous hybrid materials that are composed of metal nodes and organic linkers. To improve MOF photocatalytic activity and sorption of CO₂ the metalation and impregnation with ionic liquids (ILs) are preformed.

The internship concerns research on investigation of ILs impregnated and metal (such as Cu, Ag) modification of metal organic framework (MOF), and applied of this composites for CO₂ photoconversion. The structural modification of MOFs by more sustainable ILs is expected to enhance the CO₂ adsorption capacity, thus leading to increased CO₂ photoconversion yield. Planned research will allow for better understanding the interaction between CO₂ and ILs

adsorbed on MOFs, the impact on CO₂ conversion to hydrocarbons, and investigating the mechanisms of IL/MOF excitation and photocatalytic reactions.

Keywords : Metal Organic Framework (MOF) ; CO₂ Photoconversion ; Photocatalysis ; Ionic liquids (ILs)

Bibliography :

(1) Maina J.W. et al., *Mat. Horiz.* 2017, 4, 345; (2) Li D. et al., *Coordination Chem. Rev.* 2020, 412, 213262.; (3) Furukawa H. et al., *Science* 329 (2010) 424-428; (4) Li et al., , *Adv. Mater.* 2018, 30, 1705512; (5) Hori, Y. Springer: New York, 2008; pp 89–189; (6) S. Xu and E.A. Carter, *Chem. Rev.* 2019, 119, 6631; (7) Yaghi O.M. et.al. Wiley-VCH 2019, ISBN: 978-3-527-34502-1; (8) Camper D., *Ind. Eng. Chem. Res.* 2008, 47, 8496; (9) Wan, M. M., *ACS Appl. Mat. Interface*, 2014, 6, 12947; (10) Erto, A., *J. Colloid Interface Sci.*, 2015, 448, 41; (11) Mohamedali, M., *Chem. Eng. J.*, 2018, 334, 817; (12) Aghaie, M., *Renew. Sustain. Energy Rev.* 96 (2018) 502.

Tasks and duties entrusted to the student:

Synthesis of metal-organic frameworks based on polycarboxyl linkers and their modification. Physico-chemical characterisation of the materials obtained (especially BET analysis, CO₂ sorption, UV-Vis, PL, FTIR). Study of the activity of the obtained materials in photo- or photoelectroreduction of CO₂.

Skills to be acquired or developed:

- ✓ Advanced Understanding of Photocatalysis: The project offers the opportunity to deepen knowledge and comprehension of photocatalysis and its application in the conversion of CO₂ into valuable hydrocarbons.
- ✓ Laboratory Skills: The intern will gain hands-on experience in using a variety of laboratory instruments and techniques, such as single crystal XRD analysis, FTIR and elemental analyses, as well as SEM, DR-UV-Vis spectra, and BET isotherm.
- ✓ Analytical Skills: The intern will develop strong skills in analyzing data and interpreting the results of the photoconversion efficiency in gas and liquid phases and the reaction by-products.
- ✓ Experimental Design and Research: The internship will enable the intern to develop skills in experimental design, problem-solving, and the use of analytical methods in research.

PROFILE OF THE DESIRED STUDENT

- Minimum level of study required: **End of Bachelor**

- Field(s) of study: **Chemistry, Environmental Technology, Materials engenering and related fields**

- Scientific skills : **basics of inorganic, organic and analytical chemistry**

- Language skills required : **English (spoken, written)**

THE INTERNSHIP ASSIGNMENT:

Desired duration of the internship (in months): **3-6 month**

Desired Starting date of the mission: **November 2023 – June 2024**

Indicative weekly schedule: *35h / week*

Remuneration ? :

Erasmus grant: could be asked to your own university

Internship agreement: *an internship agreement will be signed.*

To SEA-EU students:

*If you're interested please send your CV and letter of motivation to the scientist in charge,
email : aleksandra.pieczynska@ug.edu.pl, before the date 01/10/2023.*