

PhD Project: Biohybrid CO₂ Valorization by Integrating Inorganic Photocatalysis with Bacterial Photosynthesis

Duration: 2024-2027 (36 months, starting Oct-Dec)

Location: CEA Saclay, Gif-sur-Yvette, France (22 km from Paris)

Funding: CEA PhD scholarship

Addressing climate change by converting carbon dioxide (CO₂) is a critical research area, aligning with global policy priorities. While the current landscape primarily features electro- and photo-catalytic methods using inorganic materials,¹ there is promising potential in harnessing biohybrid systems.^{2,3} These systems offer enhanced stability and flexibility, enabling selective and diverse transformation pathways, resulting in the development of economically competitive products. The project seeks to combine inorganic photocatalysis for selective CO₂ reduction into CO,⁴ utilizing CO as a carbon-based energy carrier for photosynthetic bacteria. These bacteria, in turn, generate biomass, fuel, and valuable molecules. The modularity of the strategy⁵ translates into two separable but interdependent approaches. On one hand is the development of fully aqueous photocatalytic system compatible of sharing the same environment as the bacteria, and on the other hand, development of biosynthetic system based on photosynthetic purple bacterium that utilize CO as sole carbon and energy source.

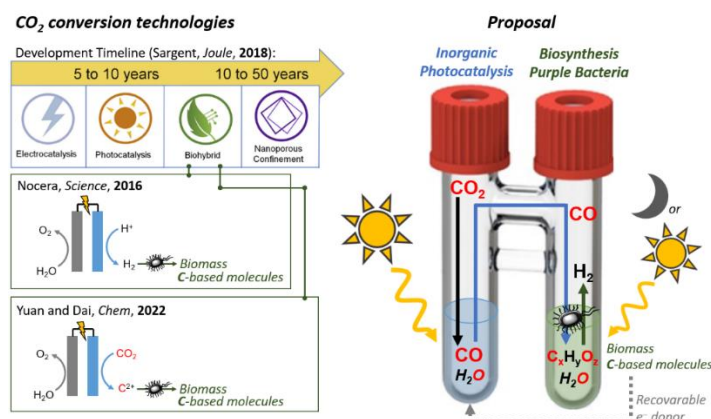


Figure 1. Envisioned biohybrid system integrating inorganic photocatalysis for reducing CO₂ to CO and bacterial photosynthesis utilizing CO to produce hydrogen, biomass, and carbon-based molecules.

The project necessitates a distinctive blend of expertise spanning the fields of chemistry, biology, and physics, which are exceptionally well established at the [Laboratory of Photobiology, Photosynthesis and Photocatalysis](#) at CEA Saclay. This expertise encompasses inorganic (electro/photo)catalyst design and performance, biological applications and physiological/biochemical characterization, as well as time-resolved spectroscopy.

Candidate Profile:

- Master's degree/diploma in chemistry or biology, with strong motivation and adaptability to learn and apply both in the project
- Good communication skills in English through written and oral presentations

The PhD student will be supervised by Dr. Anja KRIEGER-LISZKAY (biologist) and co-supervised by Dr. Philipp Gotico (chemist). Interested applicants should send their CV (with contact information of two referees), and motivation letter (with brief summary of past research experiences) to anja.lisz McKay@i2bc.paris-saclay.fr and philipp.gotico@cea.fr.

References:

- [1] Sargent, et al. *Joule* **2018**, 2, 825–832.
- [2] Nocera, et al. *Science* **2016**, 352, 1210–1213.
- [3] Dai, et. al. *Chem* **2022**, 8, 1-19.
- [4] Gotico, et. al. *Dalton Trans.* **2020**, 49, 2381–2396.
- [4] Halime, D. Audisio, et al. *Nat Commun* **2023**, 14, 4451.