

Research Topic for the ParisTech/CSC PhD Program

***Field (cf. List of fields below):** Chemistry, Physical Chemistry and Chemical Engineering

Subfield: Energy, Processes

Title: Electrochemical CO₂ Mineralization and H₂ Production

ParisTech School: Chimie ParisTech

Advisor(s) Name:

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<http://ircp.cnrs.fr/spip.php?article212>

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<http://www.upcgi.cnrs.fr/spip.php?article33>

Short description of possible research topics for a PhD:

Currently, the challenge of reducing greenhouse gas emissions of CO₂ is such that different routes are envisaged, particularly for its valorization. Thus, there are three main categories for the recovery of CO₂: the direct route (without transformation, carbon dioxide is used in industry such as petrochemicals), biological recovery (as a nutrient for photosynthetic organisms, especially algae) or use as a raw material after processing.

The objective of this project is to propose a pathway for electrochemical CO₂ mineralization, by referring to a state of the art on existing and future carbon dioxide recovery and storage processes.

CO₂ mineralization is a natural geological SLOW process that involves reacting CO₂ with abundant oxides (magnesium, calcium) to obtain stable and inert carbonates. The idea is to use the contribution of electrochemistry to provide the energy needed to increase the reaction rate.

The originality of the CO₂ electrochemical mineralization project is that it proposes a process to recycle and use the formed hydrogen and to valorize building materials or to use inexpensive alkaline ores. The energy cost of the process will be at the heart of the subject and the developed prototype will have to consist of non-membrane separators, whose cost and electrical resistance are lower and the service life longer than the membrane separators.

Required background of the student: (Which should be the main field of study of the applicant before applying)
electrochemistry

A list of 5(max.) representative publications of the group: (Related to the research topic)

- V. Lair et al., Hydrogen Energy, **2016**, DOI: 10.1016/j.ijhydene.2016.09.118.
- V. Lair et al., International Journal of Hydrogen Energy, **2016**, v41, p18721-18731.
- V. Lair et al., International Journal of Hydrogen Energy, **2015**, v40, p11378-11384.
- V. Lair et al., Frontiers Energy Research, **2015**, DOI: 10.3389/fenrg.2015.00043.
- V. Lair et al., Electrochimica Acta, **2015**, v184, p295-300.