Development of a microfluidic platform for the serial testing of CO_2-reducing electrocatalysts.

Duration : 6-month position
Location : SOLEIL Synchrotron, Paris-Saclay Campus (South of Paris, France)
Salary : about 900 € month
Starting date: February-March 2021

The accumulation of anthropogenic CO_2 in the atmosphere has dramatic consequences on life on Earth. The recycling of industrial CO_2 exhausts into valuable chemicals or fuels is an interesting solution to this worldwide problem. One route towards the generation of green fuels is the electrochemical reduction of CO_2 towards carbon-containing chemical building blocks such as CO, HCHO, HCOOH or CH_3OH. These reactions require catalysts, which need to be based on abundant elements to allow a wide-spread use. Transition metal macrocycles (porphyrins[1] or phthalocyanins[2]) have been shown to be efficient, selective and robust catalysts for the electro-reduction of CO_2 into CO. The microfluidic laboratory (MF Lab) of SOLEIL has engaged in a project on the sequential reduction of CO_2 into light hydrocarbons using milli/microfluidic electrochemical systems. This highly innovative project has been funded by a young researcher fellowship from the ANR. Its goal is to demonstrate the sequential reduction of CO_2 into formaldehyde (HCHO) and/or other more reduced chemicals, which are interesting synthons for the preparation of both basic chemicals and fuels. Our strategy consists in implementing known CO_2 and CO reduction catalysts in serial microfluidic electrochemical flow reactors.[3] In order to test a large amount of catalysts and/or catalytic conditions (flow rate, buffer, pH, potential), we would like to develop a platform for the simultaneous study of up to six catalysts/conditions. This M2 internship proposes to develop this platform and the procedure to use it to examine electrochemical behaviors and quantify products generated (liquid and gas) of multiple catalysts under different conditions. The lab is fully equipped with the required instruments (multichannel potentiostat, multichannel peristaltic pump, gas chromatograph) but the overall system and procedure to use it will have to be developed and optimized. The data generated with the platform will allow identifying catalysts with selected performances (selectivity, efficiency, robustness), which will then be studied in more detail individually. The intern will work on a day-to-day with a PhD student enrolled in his second year on this project.

We are looking for a highly motivated candidate enrolled in a Masters program in chemistry or physical chemistry and a strong interest for renewable energy research. Experience in coordination chemistry and electrochemistry is expected, while an interest for instrumentation is mandatory. Knowledge of spectroscopy and mechanical design would be a plus but is not required. Good communication skills (both written and oral) in English are expected, while the French language is not required.

Questions and applications should be sent to:
Dr. Benedikt Lassalle: benedikt.lassalle@synchrotron-soleil.fr

(1) Costentin, C.; Drouet, S.; Robert, M.; Saveant, J.-M. *Science* **2012**, *338*, 90.
(2) Boutin, E.; Wang, M.; Lin, J. C.; Mesnage, M.; Mendoza, D.; Lassalle-Kaiser, B.; Hahn, C.; Jaramillo, T. F.; Robert, M. *Angew. Chemie Int. Ed.* **2019**, *58*.
(3) Gurudayal; Perone, D.; Malani, S.; Lum, Y.; Haussener, S.; Ager, J. W. *ACS Appl. Energy Mater.* **2019**, *2*, 4551.