Post-doctoral Position – LEPMI - UMR CNRS 5279 Grenoble (France)

Title: Closed- loop recycling and re-manufacturing of noble metal electrocatalysts for energy storage and conversion devices

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Proton Exchange Membrane Fuel cell (PEMFC) and Proton Exchange Membrane Water Electrolyser (PEMWE) will play a major role in our energy transition towards sustainable energy. The core of PEMFC and PEMWE is the Membrane Electrode Assembly (MEA) which is composed of noble metal (Pt-based and Ir-based electrocatalysts respectively). The degradation of these materials upon operation is a major brake on economic growth for the large-scale deployment of these technologies in view of electric energy production and storage *via* H_2 vector. This bottleneck is mainly due to the fact that catalysts made of nanoparticles (NP) composed of noble metals (pure Pt, PtM (with M a 3d transition metal, Co or Ni) alloy for PEMFC application, Ir for PEMWE), which are mandatory elements of MEA to catalyze electrochemical reactions, are yet not recycled once degraded through working conditions.

LEPMI has acquired an important know-how on the recycling and re-manufacturing of Pt and PtCo electrocatalysts [1]. The recycling process were divided into three steps which were (i) a lixiviation to transform Pt and Co into ions; (ii) a separation of the two elements in the bimetallic Pt-based case and (iii) a re-synthesis of electrocatalysts *via* the polyol synthesis method. Ideally, this virtuous loop requires chemical processes displaying environmental impacts as low as achievable.

In the present project, we plan to use Deep eutectic solvent (DES), a new class of green solvent which attract a growing interest of physico-chemists [2,3]. Their potential in the selective extraction of Pt-based electrocatalysts will be studied. The choice of the DES is also crucial and should have the lowest carbon footprint. In that view, the widely used choline chloride, which is an organic compound containing both a quaternary ammonium and an alcohol function, will be tested. A DES composed of choline chloride and ethylene glycol has successfully allowed to dissolve various metal oxides [4]. This association could be interesting for us since ethylene glycol is a medium of choice for the synthesis of nanoarchitecture. Importantly, the stability and solubility aspects of the DES in the aqueous phase will also be deeply studied in view of re-using it several times limiting thus environmental issues.

Expected candidate profile : The candidate should possess strong bases in solution chemistry and analytical chemistry. Knowledge in electrochemistry and/or Life-Cycle Analysis will be a clear plus.

Practical informations : Post-doctoral fellowship available for 1 year renewable, based at LEPMI (France, Grenoble). Position opens from the 01st of October, 2023.

[1] L. Duclos, R. Chattot, L. Dubau, P. -X. Thivel, G. Mandil, V. Laforest, M. Bolleli, R. Vincent, L. Svecova, *Green Chem*., 22 (2020) 1919.
[2] G. Zante, M. Boltoeva, *Sustain. Chem.* 1 (2020) 238–255.
[3] N. Schaeffer et al. *Green Chem.*, 22 (2020) 2810.
[4] I. M. Pateli et al. *Green Chem.*, 22 (2020) 5476.