



Université Paris Cité

LABORATOIRE ELECTROCHIMIE MOLECULAIRE

Unité Mixte de Recherche CNRS 7591



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### Doctoral Researcher Position Opportunity in U Paris Cité, Paris, France

Electrochemical reduction of N<sub>2</sub> to ammonia with molecular Earth abundant metal complexes

Nitrogen reduction in mild conditions (room *T* and atmospheric *P*), using a non-fossil source of hydrogen remains a challenge for chemists. Nitrogen is one of the essential elements for life. Although abundant, it is nonetheless a limiting nutrient in agriculture, and crops growth is dependent on its availability. It is not only essential to the global economy as a fertilizer but also as the feedstock for industrial production of all N containing derivatives. Moreover, it has been identified as an alternative fuel as well as an energy storage molecule. Today, ca. 200 million tons of NH<sub>3</sub> are produced yearly, exclusively by the Haber-Bosch (H-B) process (equation (1)) :



Although thermodynamically favorable, the reaction is carried out at high temperature (300 - 500 °C) and high pressure (200 - 300 bars) conditions over heterogeneous Fe containing catalysts, using ca. 1 - 2% of the global energy production. It generates half a Gigaton of CO<sub>2</sub>/year (ca. ½ of the CO<sub>2</sub> generated is due to H<sub>2</sub> production by CH<sub>4</sub> reforming), a giant carbon footprint. An alternative to this process (e.g. electrochemical reduction) is mandatory.

Despite several decades of active research, only a handful of molecular catalysts (transition metal complexes including either Fe, Mo, Al, Ru) are known for this reaction, both in homogeneous and electrochemical conditions. Based on recent promising studies in our laboratory, the PhD student will contribute to a team effort aiming at exploring and optimizing molecular catalysts for N<sub>2</sub>-to-NH<sub>3</sub> reduction and implementation of the catalysts into a lab scale N<sub>2</sub> electrolyzer..

Starting date: 01/10/2023, at the earliest.  
Duration: 36 months,  
Status: Doctoral researcher.  
Funding: CIFRE (in collaboration with an industrial partner)

#### Application

The candidates are requested to send their application by e-mail to [robert@u-paris.fr](mailto:robert@u-paris.fr) as soon as possible. The application should include an updated CV, a motivation letter, an electronic copy of master degrees and the name of two relevant persons (academics) that can be contacted for any further references. Candidates will be selected based on their scientific excellence and motivation for research.

#### Additional information

Prof. Marc Robert, Email: [robert@u-paris.fr](mailto:robert@u-paris.fr)  
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