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SYNTHESIS, STRUCTURE AND ELECTROCHEMICAL PROPERTIES OF FE-N-C CATALYSTS FOR OXYGEN REDUCTION TO WATER

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Biographie

Frédéric Jaouen is a Senior Scientist of the French National Council for Scientific Research (CNRS) in Montpellier, Charles Gerhardt Institute, laboratory of Aggregates, Interfaces and Materials for Energy (AIME). His current research interests are i) the development of catalysts and complete cells based on Earth-abundant elements for low-temperature electrochemical energy conversion devices, and ii) the elucidation of structure-property relationships to rationalize and improve the electrocatalytic activity, power performance and stability performance of electrode materials, in particular those based on Earth-abundant elements or comprising ultralow amounts of precious elements.

Abstract

The oxygen electro-reduction reaction (ORR) is the cathode reaction in fuel cells, envisioned to replace combustion engines for transportation [1]. The first commercial vehicles powered by acidic-type H2/air polymer fuel cells were released in 2015. The ORR being particularly sluggish, research on novel ORR catalysts is unabated since the 1990's. While novel Pt nanostructures have allowed decreasing the amount of precious metal [2], recent advances in the class of metal-nitrogen-carbon (Me-N-C) catalysts has attracted attention [3]. Their development was initially inspired by macromolecules catalyzing ORR in the respiratory system of living organisms. Synthesized at ≥ 700 °C, modern Me-N-C catalysts are the object of intense research regarding the nature/structure of active site and ORR mechanism. Improved durability of Me-N-C catalysts is the next key practical challenge.

This presentation will report on the novel understanding acquired on a recent set of Fe-N-C catalysts comprising, in parallel with atomically-dispersed Fe ions, a controlled amount of iron-based crystalline structures, down to their complete absence. This set of catalysts has proven useful in advancing the understanding of the active site structure, role (or lack of) of Fe crystalline structures, and deactivation/degradation mechanisms [4-5].

References

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