

## Title Coordination of Fe ions atomically dispersed in nitrogen-doped carbon and their reactivity towards oxygen electro-reduction

Speaker Dr. Frédéric Jaouen

Senior Scientist, the French National Council for Scientific Research (CNRS)  
Charles Gerhardt Institute, laboratory of Aggregates, Interfaces and Materials for Energy (AIME)  
France



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Place I<sup>2</sup>CNER Hall, Ito campus, Kyushu University

### Abstract

The oxygen electro-reduction reaction (ORR) is the cathode reaction in fuel cells, envisioned to replace combustion engines for transportation. The first commercial vehicles powered by acidic-type H<sub>2</sub>/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, recent advances in the class of metal-nitrogen-carbon (Me-N-C) catalysts has attracted attention. Their development was initially inspired by macromolecules catalyzing ORR in the respiratory system of living organisms. Synthesized at  $\geq 700$  °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 focus on 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. In particular, demetallation, bulk carbon corrosion (at high electrochemical potential) and surface carbon corrosion (at normal fuel cell potential) have been studied in detail with *post mortem* and online spectroscopies. It will be shown that the FeN<sub>x</sub> moieties covalently integrated in a carbon matrix, are surprisingly resilient to a wide range of electrochemical potential, but their turnover for ORR is decreased in the presence of oxygen groups on the carbon surface.

### About the Speaker

Dr. Frédéric Jaouen obtained his *Ph.D.* at the Royal Institute of Technology (Stockholm, Sweden) in 2003, entitled “Electrochemical characterization of porous cathodes in the polymer electrolyte fuel cell”, under the supervision of Prof. Göran Lindbergh. He was then a postdoctoral researcher in the same group and developed an efficient air breathing passive PEM fuel cell. From 2004 and until March 2011, he was then a research associate in Prof. Jean-Pol Dodelet’s group at “Institut National de la Recherche Scientifique”, near Montreal, Canada. During this period, his research focused mainly on non-precious metal catalysts for the oxygen reduction reaction in PEM fuel cell. In 2011, Frédéric Jaouen was awarded an excellence chair from the “Agence Nationale de la Recherche” and moved to University of Montpellier (France) to pursue his research on non precious metal catalysts as a CNRS research fellow.

Host: Prof. Stephen Lyth

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Contact: Research Support and International Affairs division  
International Institute for Carbon-Neutral Energy Research  
Tel:092-802-6934 Email:wpikenkyu@jimu.kyushu-u.ac.jp

