DEVELOPMENT OF NON-NOBLE-METAL ELECTROCATALYSTS FOR THE OXYGEN REDUCTION REACTION

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ABSTRACT

Proton Exchange Membrane Fuel Cells (PEMFCs) are at the forefront of decarbonizing the global economy. They are among the most promising electrochemical devices because of their low operating temperature and high-power density. The state-of-the-art catalyst for the desired redox reactions (hydrogen oxidation at the anode, and oxygen reduction at the cathode) is rare platinum (Pt) and Pt-alloys. The replacement of unsustainable noble-metal catalysts with platinum group metal (PGM)-free catalysts for oxygen reduction reaction (ORR) is essential for material wise and market value viable PEMFCs[1-2]. To sustain the high rate of commercialization three main requirements must hold: the use of non-critical materials with viable cost efficiency, high performance, and elongated durability.

Among the investigated candidates, Me–N-C catalysts are the most promising[3-4]. For the development of Fe-N-C electrocatalysts, our work focuses on developing controllable and reproducible synthesis routes that will allow selective active site formation. We build our catalysts on already formed carbon-based structures (nanotubes, nanoparticles) that are properly treated and mixed with specific precursors to introduce nitrogen and atomically dispersed Fe species. Physicochemical and morphological characterization is followed by the electrochemical evaluation with respect to their intrinsic activity towards ORR and their stability in acidic media.

KEYWORDS: Carbon-based electrocatalysts, Fe-N-C, ORR activity, PEMFCs

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