Source: Sohrabi, S., Dehghanpour, S. and Ghalkhani, M., 2016. Three-dimensional metal–organic framework graphene nanocomposite as a highly efficient and stable electrocatalyst for the oxygen reduction reaction in acidic media. *ChemCatChem*, *8*(14), pp.2356-2366. DOI: 10.1002/cctc.201600298

Three-Dimensional Metal–Organic Framework Graphene Nanocomposite as a Highly Efficient and Stable Electrocatalyst for the Oxygen Reduction Reaction in Acidic Media

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Abstract

We report on the design of a bio-inspired composite as a noble-metal-free electrocatalyst for the oxygen reduction reaction (ORR). The composite is made from the assembly of pyridine- functionalized graphene (G-py) and a 3D metal–organic framework (MOF) deposited onto a glassy carbon electrode (GCE). The 3D heme-like MOF was synthesized from tetrakis(4-carboxyphenyl)porphyrin iron(III) chloride and Zr6 clusters for the assembly of the stable porous coordination network. G-py, which possesses an axial ligand to anchor to the centers of porphyrin in the MOF, results in a significant change in the electronic and geometric structure of centers, which enhances the rate of ORR and durability during cycling in acidic media. The occurrence potential of the ORR by the composite is shifted to the positive potential near 100 mV. Our results introduce a new strategy for the rational design of inexpensive and highly stable oxygen reduction electrocatalysts for fuel cells without the requirement of pyrolysis.

Link: https://chemistry-europe.onlinelibrary.wiley.com/doi/abs/10.1002/cctc.201600298