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PGM free Electrocatalyst based on Fe-N_x modified Mesoporous Carbon for Oxygen Reduction Reaction

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The scarcity and high cost of platinum, as well as the low durability of platinum-based catalysts, are serious obstacles to the large-scale commercialization of PEMFCs. Nitrogen doped mesoporous carbons are emerging as a new class of Pt free materials for ORR.[1,2] In particular, it was observed that doped carbons containing small amount of transition metals, such as Fe or Co, can catalyse the O_2 reduction to H_2O at overpotentials comparable to that of the most active Pt catalyst.[3]

In this paper, nitrogen doped mesoporous carbons containing small amount of Fe and/or Co (M@N-MC,) were prepared from several types of polysaccharides including agarose. The first step is the formation of a hydrogel embedding an iron or cobalt metalorganic complex. After the freeze-drying of the gel, the material is subjected to a first thermal treatment to obtain a crude product, which is ball milled and further activated at high temperature. XPS analysis reveals the presence of various forms of iron oxides and a distinct peak due to the Fe−N_x bond at 708.6 eV (Fig. 1a). Beside Fe-N_x not visible from TEM analysis, iron is present as big core shell NPs with iron oxide core and carbon shell.

The catalytic performances of catalyst ink prepared from M@N-MC were investigated by cyclic voltammetry and by rotating ring-disk electrode in 0.1 M $HClO_4$ attesting that O_2 is reduced following an almost $4e^-$ pathway at very positive potentials (0.6 V vs RHE) (Fig. 1b).

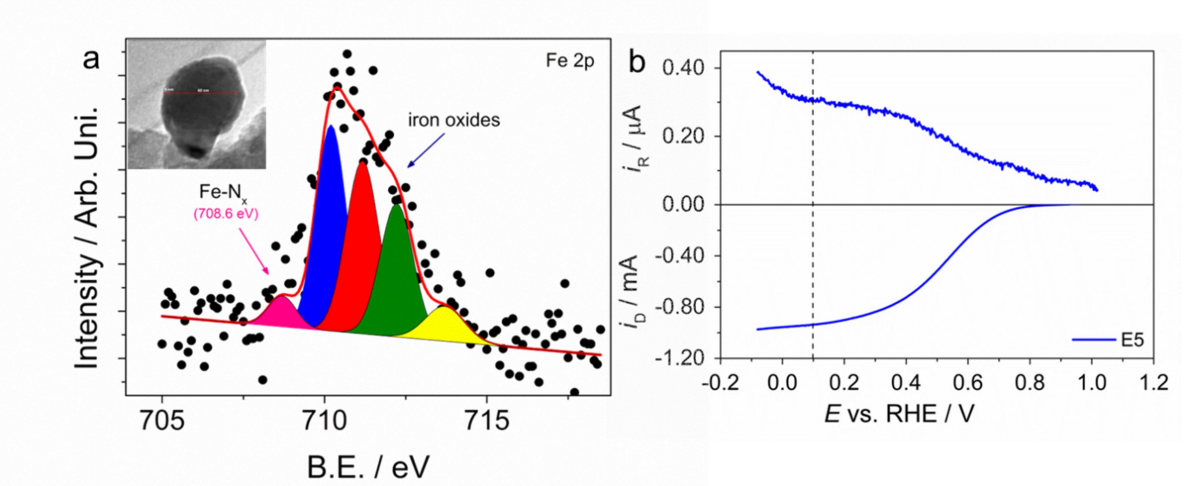

Figure 1. (a) Fe 2p XPS detailed study and deconvolution signals. (b) Example of RRDE measurement on Co@N-MC in 0.1 M $HClO_4$ at 1600 rpm and ν = 5 mV/s.

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