ELECTROCHEMICAL PROPERTIES OF COBALT-CONTAINING COMPOSITES IN OXYGEN REDUCTION REACTION

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Oxygen reduction reaction (ORR) on fuel cell cathode requires significant overpotential, and for this reason it occurs at E much lower than thermodynamically-equilibrium value 1.23 V. This overpotential is traditionally reduced with a help of catalysts, that contain noble metals, in particular platinum. High price and limited resources of Pt, along with its possible deactivation by fuel oxidation products in fuel cell, are the reasons for search and development of new efficient and stable ORR electrocatalysts, which do not contain noble metals. Among platinum-free systems, proposed up to date, so-called Me-N-C catalysts (where Me = Fe and/or Co) are among the most promising and they are considered as possible materials for platinum replacement in fuel cells. Such catalysts are usually prepared by high-temperature treatment of different compounds, which contain metals, nitrogen and carbon.

In this study we developed a method for preparation of nanosized cobalt-nitrogen-carbon composites, which was based on pyrolysis of cobalt phenantrolinate on different carriers (VulcanXC, SiO_2, Al_2O_3). The influence of treatment temperature and cobalt/phenantroline ratio on catalyst performance was studied.

It was found by cyclic voltammetry that the composites were catalytically active in electrochemical ORR in 0.5 M H_2SO_4 (E_{onset} ~ 800 mV, $E_{1/2}$ ~ 740 mV *vs.* RHE). Activity of the composites was better to typical reported analogues and comparable with the best ones (Fig. 1; the best and the worst representatives prepared by different methods were selected; data were taken from [1]).

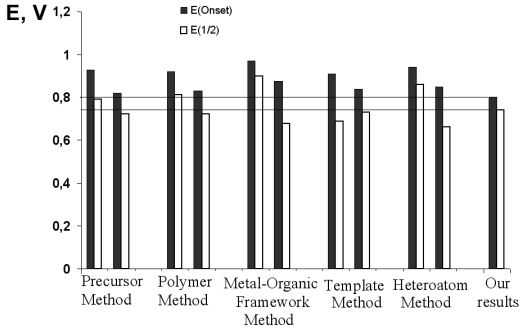

Fig. 1. Comparison of performance of the best catalyst from this study with literature analogue (see text for details)

Kinetic parameters of ORR on studied composites were determined from the experiment with rotating ring-disc electrode. It was shown by chronoamperometry that the prepared composites had high electrochemical stability.

[1] A. A. Gewirth, J. A. Varnell, A. M. DiAscro, *Chem. Rev.* 2018, 118, 2313−2339