

NiO@Pt/C Core-Shell Nanocatalyst for Oxygen Reduction Reaction

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ABSTRACT

Nowadays catalysts based on Pt and Pt-M alloy (M = Co, Ni) are materials of great interest to be applied as cathodes in proton-exchange membrane fuel cells; however the common problem in the alloys is the easily degradation of the element non-noble in acidic media, decreasing significantly its stability and performance. Currently intense investigation has been focused on the synthesis of core-shell materials, where cores of different non-noble metals have been decorated with Pt. This procedure could deeply reduce the amount of Pt used; decreasing the catalyst cost and improving catalytic activity towards oxygen reduction reaction (ORR), respect to benchmark Pt/C catalysts. These features have been related with changes on geometrical and/or electronic properties owing to M-Pt interactions. In this work, we present the synthesis, as well physical and electrochemical characterization of the nickel oxide supported in Ketjenblack carbon decorated platinum core-shell nanocatalyst for the oxygen reduction reaction (ORR) in acid media. The core was synthesized by chemical reduction with NaBH₄ of Ni(NO₃)₂·6H₂O, while the shell was deposited by galvanic displacement on the surface of Ni nanoparticles. The presence of Pt in the core was proved by XRD. On the other hand, TEM micrographs have showed highly dispersed nanoparticles with an average between 2-20nm. The presence of Ni and Pt on 71 and 29 wt. % respectively was confirmed by EDAX while XPS and Raman spectroscopy confirms the presence of NiO. The electrochemical performance of NiO@Pt/C is evaluated by cyclic voltammetry, CO stripping and using rotating disk electrode setup, was carried out for the ORR in HClO₄ electrolyte; indicated that have more catalytic activity than that of commercial 20% Pt / C-Etek® catalyst, used as reference.

Keywords: NiO:Pt core-shell nanoparticles; oxygen reduction reaction, electrochemical analysis.

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