OXYGEN REDUCTION ACTIVITY OF COBALT-NITRIDE ON NITROGEN-DOPED GRAPHENE

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Abstract:

Fuel cells technology can offer suitable alternatives to replace one of the most important environmental issues of our days, i.e., fossil fuels. In the last decades, non-precious metal catalysts came in the view such as transition metal-oxides, -nitrides, or even metal free catalysts like N-graphene. Such systems are expected to replace high cost oxygen reduction reaction (ORR) catalysts used nowadays [1]. We hereby demonstrate a simple method for the simultaneous synthesis of cobalt-nitride nanoparticles on nitrogen-doped graphene support. The reported non-precious metal catalyst showed high electrocatalytic activity in ORR, and thus it is a promising alternative cathode-side catalyst in polymer electrolyte membrane (PEM) fuel cells. The catalyst was synthesized from lyophilized graphene-oxide and cobalt(II)-acetate in NH_3 flow at high temperature, and the effect of cobalt-nitride amount on catalyst properties was further examined. To this end, transmission electron microscopy (TEM) and X-ray diffractometry (XRD) were employed to monitor the morphological and structural changes in the graphene sheets and the supported cobalt-nitride particles. The electrochemical properties of the catalyst were investigated in a three-electrode cell in oxygen saturated 0.1 M potassium-hydroxide solution at different rotation rates with a rotating disk electrode (RDE) setup. The optimal amount of cobalt-nitride and nitrogen-doped graphene was determined, producing a promising non-precious metal catalyst for oxygen reduction reaction.

[1] ZHANG, Jiujun (ed.). PEM fuel cell electrocatalysts and catalyst layers: fundamentals and applications. Springer Science & Business Media, 2008., 89-134