Synthesis and characterization of iron- and nitrogen-functionalized graphene catalysts for oxygen reduction reaction

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Abstract

Iron- and nitrogen-functionalized graphene (Fe-N-G), as well as iron- and nitrogen-functionalized oxidized graphene (Fe-N-Gox) catalysts were synthesized as non-noble metal electrocatalysts for oxygen reduction reaction (ORR). The physical properties of the resultant catalysts were characterized using nitrogen adsorption measurements, X-ray diffraction, Raman and X-ray photoelectron spectroscopies and transmission electron microscopy. Subsequently, ORR activities of the catalysts were determined electrochemically using a conventional three-electrode cell via cyclic voltammetry with a rotating disc electrode, the results of which indicated that the synthesized catalysts had a marked electrocatalytic activity towards ORR in acid media. Among the synthesized catalysts, that functionalized using 2,4,6-tris(2-pyridyl)-1,3,5-triazine as nitrogen source had the highest electrocatalytic activity with the highest onset potential (0.98 V/SHE) and limiting current density (5.12 mA cm^{-2}). The findings are particularly important to determine a non-precious metal catalyst for ORR activity in fuel cells.

Keywords: fuel cell; graphene;non-precious metal catalyst; oxygen reduction reaction; rotating disc electrode

DOI: 10.1002/aoc.3738