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Influence of Co doping on physiochemical properties of MnFe2O4/C nano compounds toward oxygen reduction reaction

Mphoma S. Matseke [ab], Haitao Zheng[a], Mkhulu K. Mathe[a], Emanuela Carleschi[c] Bryan Doyle[c]

[a] Energy Centre, Council for Scientific and Industrial Research (CSIR), Pretoria 0001, South Africa
[b] Department of Chemical Sciences, University of Johannesburg, Johannesburg 2006, South Africa
[c] Department of Physics, University of Johannesburg, Johannesburg 2006, South Africa

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Abstract

Recently, several researchers have found that the manganese ferrite (MnFe2O4) nanoparticle can be a promising candidate for the oxygen reduction reaction (ORR). However, the MnFe2O4 nanoparticles still face challenges on their ORR activity and stability for practical application. In this work. The Co-doped MnFe2O4 electrocatalysts are explored to improve their intrinsic activity for the ORR in alkaline electrolytes. The MnFe2−xCoxO4/C (x = 0.25–0.75) electrocatalysts show significant improvements on the ORR performance, particularly the MnFe1.5Co0.5O4/C electrocatalyst exhibits the best ORR performance with 80 mV positive shift in half-wave potential compared to the pristine MnFe2O4. Meanwhile, the MnFe1.5Co0.5O4/C nanoparticles display a uniform spherical shape with a size of ~11–15 nm, compared to the irregular shapes of the MnFe2O4/C nanoparticles with sizes in the range of ~8-~70 nm. The Co doping has redistributed the cations between the tetrahedral and octahedral sites in the MnFe2O4 structure from the XRD, TEM, FTIR, and XPS analysis. Furthermore, the particles sizes of the doped MnFe2O4/C nanoparticles are smaller and uniform, with more oxygen vacancies. In addition, the Co doping has enriched the surface Mn3+ ions and improved the conductivity of the MnFe2O4/C nanoparticles. The above results are closely related to the enhanced ORR activity of the Co-doped MnFe2O4/C compared to the pristine of the MnFe2O4/C.