Enhanced oxygen evolution activity of Co3−xNixO4 compared to Co3O4 by low Ni doping

Aditi Singhal, Anuj Bisht, Silvia Irusta

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Enhanced Oxygen Evolution Activity of $Co_{3-x}Ni_xO_4$ compared to Co_3O_4 by low Ni doping

Aditi Singhal[1*] Anuj Bisht[2] and Silvia Irusta[3]

1. School of Engineering and Applied Science, Ahmedabad University, Ahmedabad-380009, Gujarat, India, Email: aditi.singhal@ahduni.edu.in
2. Department of Chemistry, Indian Institute of Technology Gandhinagar, Palaj, Gandhinagar - 382355, Gujarat, India
3. Department of Chemical Engineering, Nanoscience Institute of Aragon (INA), University of Zaragoza, 50018 Zaragoza, Spain

Abstract:

We herein report a series of nanocrystalline Ni-doped Co_3O_4: $Co_{3-x}Ni_xO_4$ ($0.0075 \leq x \leq 0.30$) with a nickel doping percentage from 0.25 to 10 atomic percent synthesized using solution combustion method. These oxides are characterized by XRD and show pure nanocrystalline phase of Co_3O_4 with no separated peaks related to Ni/NiO_x and confirms that Ni has been substituted in the lattice. TEM results indicate that the morphology and size of all the compounds are similar. Electrochemical measurements indicate that Co_3O_4 and $Co_{3-x}Ni_xO_4$ are active for oxygen evolution reaction (OER) and also shows that that low amount of nickel doping in Co_3O_4 can remarkably enhance OER activity in neutral, alkaine and buffer (pH-7) electrolytes. Out of all compositions, 0.5% Ni-doped Co_3O_4 ($Co_{2.985}Ni_{0.015}O_4$) seems to be more active than Co_3O_4 in terms of both current density and onset potential in K_2SO_4 medium. The enhancement in terms of OER activity, however, decreases until the doping concentration reaches beyond 0.5%. Phosphate buffer solution (PBS) studies reveal that Co_3O_4 and 0.5% Ni-doped Co_3O_4 show OER at near thermodynamic potential. Detailed x-ray photoelectron spectroscopy (XPS) studies have indicated that surface oxygen (lattice oxygen) concentration is an important factor in deciding the OER activity which is highest for 0.5% Ni doped Co_3O_4 ($Co_{2.985}Ni_{0.015}O_4$) and hence gives the highest OER activity.

Introduction