Issue 36, 2020

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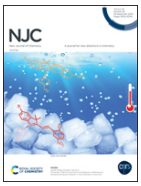


From the journal:
New Journal of Chemistry

Cobalt oxide nanoparticle-decorated reduced graphene oxide (Co_3O_4–rGO): active and sustainable nanoelectrodes for water oxidation reaction †

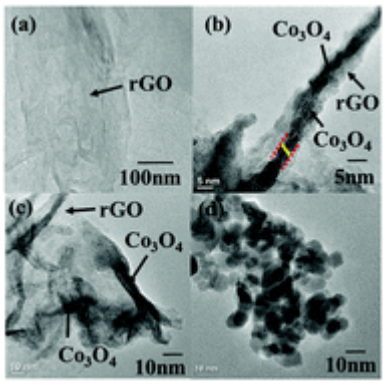
Ajay V. Munde ,[a] Balaji B. Mulik ,[a] Raviraj P. Dighole [a] and Bhaskar R. Sathe *[a]

Author affiliations

Abstract

Herein, cobalt oxide (Co_3O_4)-decorated reduced graphene oxide (rGO)-based nanoelectrodes were fabricated by the chemical reduction method using hydrazine hydrate. It showed enhanced electrocatalytic activity for oxygen evolution (water oxidation) reactions (OER) in an alkaline medium. These as-synthesized materials were characterized by X-ray diffraction (XRD), Fourier transform-infrared (FT-IR) spectroscopy, energy dispersive analysis of X-ray (EDAX), Raman spectroscopy and transmission electron microscopy (TEM). The XRD studies confirmed that Co_3O_4 had a cubic spinal structure and morphological studies based on TEM analysis showed that Co_3O_4 existed with ~5 nm-thick chain-like nanostructures that decorated rGO. This Co_3O_4-modified reduced graphene oxide (Co_3O_4–rGO) electrocatalyst was found to be extraordinarily active towards oxygen evolution reactions (OER) and is one of the complex reactions of water splitting technique. This was further confirmed by an ultra-low onset potential of 1.38 V *vs.* RHE with a high current density of 10 mA mg^{-1} of Co_3O_4 loading (calculated from TGA) at the constant potential of 1.50 V *vs.* RHE. The enhancement factor of Co_3O_4–rGO = 2000 was almost 3.25 times higher compared with that of Co_3O_4 = 600 under similar electrolytic conditions probably due to the synergetic co-operative interactions at modified interfaces. Chronoamperometric (*i*–*t*) and electrochemical impedance spectroscopic (EIS) measurements

demonstrated higher current/potential stability and lower charge transfer resistance, respectively, for Co_3O_4–rGO compared with those of rGO and Co_3O_4 towards the water oxidation reaction.



Supplementary files

Supplementary information
PDF (641K)

Article information

https://doi.org/10.1039/D0NJ02598D

Article type
Paper

Submitted
23 May 2020

Accepted
14 Aug 2020

First published
19 Aug 2020

Citation
New J. Chem., 2020, **44**, 15776-15784

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