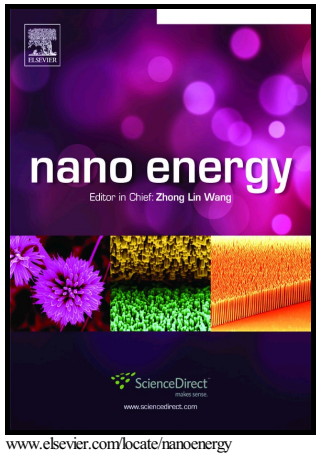
A highly stable bifunctional catalyst based on 3D $Co(OH)_2$@NCNTs@NF towards overall water-splitting

Pan Guo, Jian Wu, Xi-Bo Li, Jun Luo, Woon-Ming Lau, Hao Liu, Xue-Liang Sun, Li-Min Liu



www.elsevier.com/locate/nanoenergy

PII: S2211-2855(18)30101-0
DOI: https://doi.org/10.1016/j.nanoen.2018.02.032
Reference: NANOEN2519

To appear in: *Nano Energy*

Received date: 8 January 2018
Revised date: 14 February 2018
Accepted date: 15 February 2018

Cite this article as: Pan Guo, Jian Wu, Xi-Bo Li, Jun Luo, Woon-Ming Lau, Hao Liu, Xue-Liang Sun and Li-Min Liu, A highly stable bifunctional catalyst based on 3D $Co(OH)_2$@NCNTs@NF towards overall water-splitting, *Nano Energy,* https://doi.org/10.1016/j.nanoen.2018.02.032

A highly stable bifunctional catalyst based on 3D $Co(OH)_2$@NCNTs@NF towards overall water-splitting

Pan Guo[‡1,2], Jian Wu[‡4], Xi-Bo Li[‡1], Jun Luo[5], Woon-Ming Lau[4], Hao Liu[2*], Xue-Liang Sun[6*], Li-Min Liu[1,3*]

[1]Beijing Computational Science Research Center, Beijing 100193, China
[2]Chengdu Green Energy and Green Manufacturing Technology R&D Center, Chengdu Development Center of Science and Technology of CAEP, Chengdu, Sichuan, 610207, China
[3]School of physics, Beihang University, Beijing 100191, P. R. China
[4]Center for green Innovation, School of Mathematics and Physics, University of Science and Technology Beijing, Beijing 100083, China
[5]Tianjin Key Laboratory of Advanced Functional Porous Materials and Center for Electron Microscopy, School of Materials Science and Engineering, Tianjin University of Technology, Tianjin 300384, China
[6]Department of Mechanical and Materials Engineering, the University of Western Ontario, London, Ontario, N6A 5B9, Canada

[‡] contributed equally to this work

Email: liminliu@buaa.edu.cn or limin.liu@csrc.ac.cn; mliuhao@gmail.com; xsun@eng.uwo.ca

Abstract

Electrocatalysts with low overpotential and high stability are highly demanded in water-splitting system. The efficiency of water-splitting is largely restricted by the oxygen evolution reaction (OER). Here, we developed a two-step method to prepare 3D porous material through chemical vapour deposition and electrodeposition combined with the first-principles calculations. Ultrathin α-$Co(OH)_2$ nanosheets grown on the combined substrate of N-doped carbon nanotubes (NCNTs) and nickel foam were fabricated to investigate their electrochemical behaviour. Because of the characteristics of the ultrathin, microporous α-$Co(OH)_2$ and its derivatives, the 3D $Co(OH)_2$@NCNTs@NF exhibits outstanding performance as a bifunctional catalyst for water-splitting. The overpotentials to achieve 10 mA cm^{-2} current density in 1 M KOH for OER and hydrogen evolution reaction (HER) are 270 mV and 170 mV, respectively. The as-prepared material exhibits superior stability, which generate 10 mA cm^{-2} current density in overall water-splitting over 600 hours without obvious degradation in 1 M KOH at voltage of 1.72 V *vs.* RHE. The first-principles calculations reveal that the N-doping not only can effectively enhance the interaction