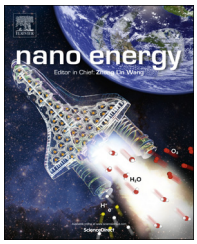
Nano Energy (2014) 9, 373–382

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/nanoenergy



RAPID COMMUNICATION

Cobalt phosphide nanorods as an efficient electrocatalyst for the hydrogen evolution reaction

Zhipeng Huang[a,*], Zhongzhong Chen[a], Zhibo Chen[a], Cuncai Lv[a], Mark G. Humphrey[b], Chi Zhang[a,*]

[a]China-Australia Joint Research Center for Functional Molecular Materials, Scientific Research Academy, Jiangsu University, Zhenjiang 212013, Jiangsu, PR China
[b]Research School of Chemistry, Australian National University, Canberra, ACT 0200, ACT, Australia

Received 13 June 2014; received in revised form 11 August 2014; accepted 18 August 2014
Available online 26 August 2014

KEYWORDS
Cobalt phosphide;
Nanorod;
Electrocatalyst;
Hydrogen generation

Abstract
Cobalt phosphide (Co_2P) nanorods are found to exhibit efficient catalytic activity for the hydrogen evolution reaction (HER), with the overpotential required for the current density of 20 mA/cm^2 as small as 167 mV in acidic solution and 171 mV in basic solution. In addition, the Co_2P nanorods can work stably in both acidic and basic solution during hydrogen production. This performance can be favorably compared to typical high efficient non-precious catalysts, and suggests the promising application potential of Co_2P nanorods in the field of hydrogen production. The HER process follows a Volmer–Heyrovsky mechanism, and the rates of the discharge step and desorption step appear to be comparable during the HER process. The similarity of charged natures of Co and P in the Co_2P nanorods to those of the hydride-acceptor and proton-acceptor in highly efficient Ni_2P catalysts, [NiFe] hydrogenase, and its analogues implies that the HER catalytic activity of the Co_2P nanorods might be correlated with the charged natures of Co and P.

Introduction

The solar-driven splitting of water into molecular hydrogen and oxygen is one of the most promising possibilities for simultaneously solving the global energy crisis and current environmental issues [1–3]. Because of the intrinsically slow hydrogen evolution reaction (HER) kinetics of semiconductors, photocathodes must be decorated with HER catalysts for efficient hydrogen production. Though platinum remains the most effective HER catalyst, having been shown to significantly enhance the hydrogen production capability of photocathodes several decades ago [4,5], it is a limited resource and expensive, and so its widespread practical

*Corresponding authors. Tel./fax: +86 511 88797815.
E-mail addresses: zphuang@ujs.edu.cn (Z. Huang), chizhang@ujs.edu.cn (C. Zhang).

http://dx.doi.org/10.1016/j.nanoen.2014.08.013
2211-2855/