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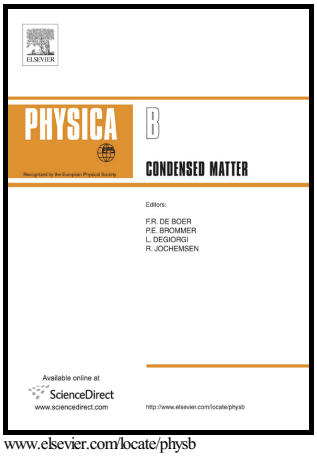

www.elsevier.com/locate/physb

PII: S0921-4526(17)30354-X
DOI: http://dx.doi.org/10.1016/j.physb.2017.06.054
Reference: PHYSB310032

To appear in: *Physica B: Physics of Condensed Matter*

Received date: 21 April 2017
Revised date: 5 June 2017
Accepted date: 19 June 2017

Cite this article as: Kelebogile Maabong, Augusto G.J. Machatine, Benard S Mwankemwa, Artur Braun, Debajeet K. Bora, Rita Toth and Mmantsae Diale Nanostructured hematite thin films for photoelectrochemical water splitting *Physica B: Physics of Condensed Matter* http://dx.doi.org/10.1016/j.physb.2017.06.054

Nanostructured hematite thin films for photoelectrochemical water splitting

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Abstract
Nanostructured hematite thin films prepared by dip coating technique were investigated for their photoelectrochemical activity for generation of hydrogen from water splitting. Structural, morphological and optical analyses of the doped/undoped films were performed by X-ray diffraction, high resolution field emission-scanning electron microscopy, UV-vis spectrophotometry and Raman spectroscopy. The photoelectrochemical measurements of the films showed enhanced photoresponse and cathodic shift of the onset potential upon Ti doping indicating improved transfer of photoholes at the semiconductor-electrolyte interface. Films doped with 1 at.% Ti produced 0.72 mA cm^{-2} at 1.23 V *vs* RHE which is 2 times higher than current density for the pure film (0.30 mA cm^{-2}, at 1.23 V *vs* RHE). Gas chromatography analysis of the films also showed enhanced hydrogen evolution at 1 at.% Ti with respect to pure film.

KEYWORDS: Hematite; thin films; dip coating; Ti-doping; photoelectrochemical; gas chromatography.

1. Introduction

Photoelectrochemical (PEC) water splitting utilises sunlight energy to drive chemical reactions to produce energy in the form of electrical energy and chemical fuel [1, 2]. Hematite (α-Fe_2O_3) is considered an attractive material for PEC water splitting due to its narrow indirect band gap energy (1.9 - 2.3 eV) which allows photon absorption in the visible region of solar radiation ($400 \leq \lambda \leq 600$ nm), and high chemical/electrochemical stability in aqueous environment. Despite its shortcomings such as improper alignment of the conduction band edge to water reduction potential level, short hole diffusion length (< 5nm), low hole mobility and short excited lifetime (10 ps) [3, 4], α-Fe_2O_3 continues to attract considerable attention as a promising material for PEC generation of hydrogen, with recent research efforts focused towards understanding of charge transfer kinetics at the semiconductor-electrolyte interface[3, 5, 6]. A number of strategies have been adopted to suppress recombination and