ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim

IIUM PRESS
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ADVANCES IN MATERIALS ENGINEERING VOLUME 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Md Abdul Maleque, Iskandar Idris Yaacob & Zahurin Halim: Advances in Materials Engineering

ISBN: 978-967-418-168-0

Member of Majlis Penerbitan Ilmiah Malaysia -- MAPIM
(Malaysian Scholarly Publishing Council)

PRINTED BY:
IIUM PRINTING SDN.BHD.
NO. 1, JALAN INDUSTRI BATU CAVES 1/3
TAMAN PERINDUSTRIAN BATU CAVES
BATU CAVES CENTRE POINT
68100 BATU CAVES
SELANGOR DARUL EHSAN
TEL: +603-6188 1542 / 44 / 45 FAX: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

Table of Content

Chapter 020

Natural Dye Coated Nanocrystalline TiO_2 Electrode Films for DSSCs

Souad. A. Mohamad[1] and Iraj Alaei[2]
[1, 2.] Faculty of Engineering – International Islamic University Malaysia
✉/su3ad@iium.edu.my , irajalaci@yahoo.com

Keywords: Natural dyes, Solar cells, DSSCs, Liquid electrolyte, Solid electrolyte

Abstract. Nanocrystalline TiO_2 thin films were successfully prepared by dip-coating technique on ITO conductive glass substrates at low temperature. Dye-sensitized solar cells based on these films have exhibited high overall light-to-electricity conversion efficiency of 4.67 % under illumination intensity 100 mW/cm^2.

Introduction

Natural dyes find use in the coloring of textiles and food products (have nontoxic effects), drugs, cosmetics, etc. A huge number of plants all over the world can yield dyes. In addition to their dye-yielding characteristics, some of these plants also possess medicinal value. Though there is a large plant resource base, little has been exploited so far. Due to lack of availability of precise technical knowledge on the extracting and dyeing technique, it has not commercially succeeded like the synthetic dyes [1]. One more additional application of natural dyes is in the photovoltaic technology, particularly in the fabrication of dye sensitized solar cells.

Dye-sensitized solar cells (DSSCs) based on nanocrystalline TiO_2 thin film electrodes have been attracting a lot of interests due to high energy conversion efficiencies and low production cost [2-4]. Nanocrystalline TiO_2 thin film electrodes are commonly prepared by coating TiO_2 colloid with organic additives on conductive glass substrates and annealing at high temperature of 450°C-500 to remove °C organic additives and connect TiO_2 particles to form mechanically stable film.

In this chapter, a nanocrystalline TiO_2 thin film electrodes was prepared at room temperature and optimized Ti (IV) precursors and the solvents.

Experimental

A commercial nanocrystalline TiO_2 powder (Degussa P25 70 % anatase and 30 % rutile) was mixed with 3.6 g of a 1 mol/L *n*-butanolic solution of tetrabutyl titanate [Ti $(OC4H9)_4$] and stirred in a closed glass container for about 2 h to obtain a paste of appropriate viscosity. The raw films were produced by coating the paste with doctor-blade method on the glass substrates (ITO), and then dried at room temperature. The raw films can be treated by cooked in a container full of water at 100°C for 4 h. The raw and treated films were heated at 100°C for 1 h, and then immersed in a 0.0005 mol/L ethanol solution of natural dye overnight at room temperature. The cells employed dye adsorbed films as the working electrodes and platinum foils as the counter electrodes to assemble the sandwich DSSCs. The electrolyte was