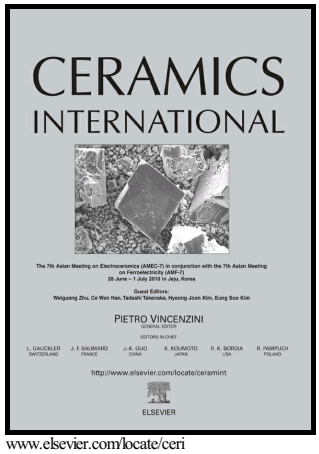

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Advanced Visible-Light Photocatalytic Property of Biologically Structured Carbon/Ceria Hybrid Multilayer Membranes Prepared by Bamboo Leaves

Chencheng Wang[a], Feng Chen[b], Yuanzheng Tang[b], Xiao Chen[b], Junchao Qian[b],

Zhigang Chen[a,b*]

[a] School of Material Science and Engineering, Jiangsu University, Zhenjiang 212013, China

[b] School of Chemistry, Biology and Materials Engineering, Suzhou University of Science and Technology, Suzhou215009, China

Abstract: Biologically structured carbon/cerium dioxide materials are synthesized by biological templates. The microscopic morphology, structure and the effects of different oxidation temperatures on materials are characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD) ultraviolet-visible light spectrum (UV-Vis) and X-ray Photoelectron Spectroscopy (XPS). Moreover, by splitting water under visible light irradiation, the hydrogen production is measured to test the photocatalytic property of these materials. The results show that materials made with bamboo biological templates which are immersed in 0.1 mol•L^{-1} of cerium nitrate solution, then carbonizated in nitrogen (700 ℃) and oxidized in air (500-600 ℃), can obtain the biological structure of bamboo leaves. The product is in the composition of hybrid multilayer membrane, which one is carbon membrane form plant cell carbonation and another is ceria membrane by nanoparticle self assembly. The best oxidation temperature is 550 ℃ and the band gap of carbon/cerium dioxide materials synthesized at this optimum oxidation temperature could be reduced to 2.75 eV. After exposure to visible light for 6 hours, the optimal hydrogen production is about 302 μmol•g^{-1}, which is much higher than that of pure CeO_2.

Keywords Biologically Structured; Carbon; Cerium Dioxide; Hybrid Multilayer Membrane; Photocatalytic Property

0 Introduction

For a long time, energy issues have garnered much attention from various industries in society. Storage capacity and exploitation of traditional fossil energy such as coal, oil and natural gas are far from meeting demands. The burning of unclean fossil fuels also causes problems like acid rain[1], the greenhouse effect[2,3] and haze[4] which not only do harm to the environment, but also to human health[5]. Therefore, the need for a new and efficient energy to replace fossil fuels is an urgent problem to be solved. Inexhaustible solar energy is a substitute for fossil fuels[6], however, humans can not directly use solar energy as a resource, but rather need to convert solar energy into other energy sources to indirectly use[7]. Although silicon, germanium and derivatives can convert solar energy into electrical and thermal energy[8], conversion efficiency is not really satisfactory. Inspired by photosynthesis in plants and algae, creatures which can transform solar energy into chemical energy[9-11], researchers have suggested that a semiconductor can be used as a catalyst to convert solar energy into the chemical bonds of certain clean energy materials[12], such as methanol[13-15] , hydrogen[16-20] and others[21,22].

*czg@ujs.edu.cn (Corresponding author: Zhigang Chen)