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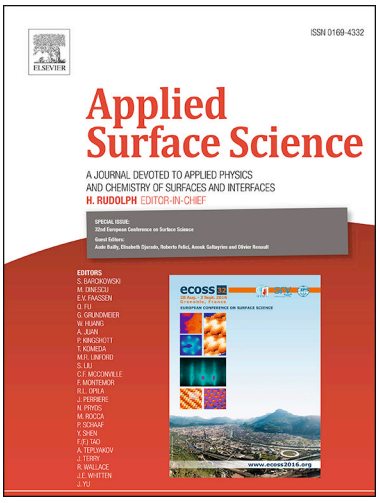

Full Length Article

Low Temperature RF Plasma Nitriding of Self-Organized TiO_2 Nanotubes for Effective Bandgap Reduction

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Low Temperature RF Plasma Nitriding of Self-Organized TiO_2 Nanotubes for Effective Bandgap Reduction

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Abstract

Titanium dioxide is a widely studied semiconductor material found in many nanostructured forms, presenting very interesting properties for several applications, particularly photocatalysis. TiO_2 nanotubes have a high surface-to-volume ratio and functional electronic properties for light harvesting. Despite these manifold advantages, TiO_2 photocatalytic activity is limited to UV radiation due to its large band gap. In this work, TiO_2 nanotubes produced by electrochemical anodization were submitted to plasma nitriding processes in a PECVD reactor. The plasma parameters were evaluated to find the best conditions for gap reduction, in order to increase their photocatalytic activity. The pressure and RF power density were varied from 0.66 to 2.66 mbar and 0.22 to 3.51 W/cm^2 respectively. The best gap reduction, to 2.80 eV, was achieved using a pressure of 1.33 mbar and 1.75 W/cm^2 RF power at 320 °C, during a 2-h process. This leads to a 14% reduction in the band gap value and an increase of 25.3% in methylene blue reduction, doubling the range of solar photons absorption from 5 to 10% of the solar spectrum.

Keywords: Nitriding; TiO_2; Nanotubes; Bandgap reduction; Photocatalysis

1 Introduction

The efficient use of solar energy in engineering is a challenge the scientific community has been on in recent years. In this context, the semiconductor characteristics of titanium