Preparation and Characterization of Nano-TiO_2 Thin Films by Sol-gel Dip-coating Method

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ABSTRACT

Anatase nanocrystalline titania (nano-TiO_2) thin films were deposited on glass slide substrates by a sol-gel dip-coating method. The sol-gel of nano TiO_2 was prepared in a home-made nitrogen dry box and titanium tetraisopropoxide $Ti[OCH(CH_3)_2]_4$ was used as a precursor. The effects of calcination temperatures on the thin films were discussed. The films were characterized by X-ray diffraction, UV-Vis spectrometry and Scanning Electron microscopy. The calcined samples show crystallinity with (101) preferred orientation which the higher crystallinity shows the better transmittance. The optical measurement shows the indirect bandgap of 3.3 eV to 3.5 eV corresponding with crystallite sizes from 8.1 nm to 2.7 nm and the transmittance of 80%.

Key words: Titania (TiO_2), Thin Films, Nanocrystalline, Sol-gel dip-coating Method

INTRODUCTION

Nanocrystalline titanium dioxide or titania (nano-TiO_2) has gained considerable attention due to its important roles in many applications such as photocatalysis (Fujishima et al., 2000), photo-induced water splitting for hydrogen production (Nowotny et al., 2005), dye-sensitized solar cells (Gratzel, 2003) and environmental purification (Zhao and Zang, 2003). Titania occurs in three crystalline forms: rutile, anatase, and brookite. Excellent review on TiO_2 was given by Diebold (2003). Among these forms, anatase-type TiO_2 exhibits superior photocatalytic properties and when compared to any other form of titania. It has been shown that the properties of titania depend on size, morphology and crystalline forms and these characters also rely on processing conditions. Recently, many researches have emphasized on the preparation and characterization of TiO_2 anoparticles, nanostructured thin films, and nanocrystalline powders (Ni et al., 2007) as well as TiO_2 nanotubes (Mor et al., 2007). One of beneficial characters of nanosized TiO_2 as a photocatalyst is its high surface-to-volume ratio providing more reactive sites at surface for photocatalytic reaction.