High Bactericidal Ability of Silver (Ag)-Coated TiO_2 Films via Doctor Blade Technique

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ABSTRACT

Films and nanoparticles of P25, precipitated (ppt.) TiO_2, 1.5%Ag-loaded TiO_2 and 1.5%Ag-loaded P25 were used as photocatalysts in bactericidal reactions. P25 powder was obtained commercially while nanoparticles of ppt. TiO_2, Ag-TiO_2 and Ag-P25 were prepared by hydrolysis and co-precipitation reactions. Brookite crystal structure was found more in Ag-TiO_2 powder than in TiO_2 powder, indicating that Ag ions influenced the crystallization of TiO_2. All the films were fabricated by doctor blade technique. The Ag-doped samples showed highest bactericidal activities. However after being washed, the doped powder became ineffective. Unlike the doped powder, the doped films still performed well after being washed, indicating that Ag was strongly adhered to the films. This work succeeded in preparing highly-effective bactericidal films via a simple doctor blade technique.

Keywords: TiO_2, bactericidal, Ag, film, dissolution

INTRODUCTION

Disinfection is necessary in drinking and household water. It is an important function of swimming pool, floor tile, window and clothes. It has been known that, when exposed to UV light, TiO_2 generates holes which directly oxidise organic materials or react with water and oxygen, producing hydroxyl (OH) radicals which are highly reactive. These radicals damage the cell wall (Kuhn et al., 2003) and cell membrane of bacteria (Zhang et al., 2003). It causes abnormal cell division and physicochemical alteration of the cell membrane (Amezaga-Madrid et al., 2003]. Silver (Ag) and silver ions have been known to be able to kill germ. They could be reused, handled more easily and more economically if impregnated on substrates. Since TiO_2 is environmental friendly, Ag coated TiO_2 (Ag-TiO_2) has been widely studied (Sokmen et al., 2001; Zhang et al., 2003). Several work reported that Ag-TiO_2 particles have high bactericidal abilities. However, we found that the dissolved Ag ions (Sokmen et al., 2001), not photocatalytic reaction, were the reason for bacteria reduction. The dissolution of Ag ions results in system contamination and life-time shortening of the photocatalysts. Various work incorporated Ag in TiO_2 films