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Sol-gel Synthesis of Nanoparticulate Titanium Dioxide: Effects of Initial Reagents

Synthesis of pure anatase TiO₂ with particle sizes smaller than 100 nanometers has been one of the focuses in the area of photocatalysts. In order to achieve the desired chemical composition and particle size, appropriate initial reagents are required. This study aimed at examining effects of sol-gel initial reagents, specifically titanium (IV) isopropoxide (TTIP), sub-micrometer- sized titanium dioxide dissolved in sulfuric acid, and titanium dioxide dissolved in sulfuric acid with addition of polyacrylic acid, on chemical compositions and particle sizes of TiO₂ powders. Experimental results indicated that preparation of nanoparticulate titanium dioxide, with the average size ranging from 48 to 85 nanometers, could be achieved when using TTIP and sub-micrometer- sized titanium dioxide dissolved in sulfuric acid with addition of polyacrylic acid as initial reagents. The results also revealed that the finest average particle size was attained in the powder prepared from TTIP. For the powder prepared from sub-micrometer- sized titanium dioxide dissolved in sulfuric acid without addition of polyacrylic acid, larger particle sizes with an average of 130 nanometers were present. In addition, formation of a secondary phase, identified as titanium oxide sulfate, was observed. Chemical compositions as well as particle sizes were discussed with respect to structures of the initial reagents and polymerization reactions potentially occurred during the sol-gel process. Antibacterial activity of the powder prepared from sub-micrometer-size titanium dioxide dissolved in sulfuric acid with addition of polyacrylic acid was evaluated. Reduction of *Staphylococcus aureus* by more than 99.9% was observed.

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