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Effect of Synthesis Conditions on the Structural, Photocatalic, and Self-Cleaning Properties of TiO_2 Nanoparticles

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Received: August 13, 2019
Revised: August 30, 2019
Accepted: September 2, 2019

TiO_2 nanoparticles were synthesized via the hydrothermal method. As-synthesized TiO_2 properties were characterized by XRD, EDX, FESEM, FTIR, and UV-Vis spectroscopy. Indicated peaks in XRD patterns confirm formation of TiO_2 nanoparticles with the anatase phase. Average crystallite sizes and strain were estimated from the XRD main peaks of all samples through Williamson–Hall method. Optical energy band gap of TiO_2 was determined to be about 3.27−3.44 eV, which appeared higher than those of other researches for anatase TiO_2 (3.20 eV). Also, increasing temperatures and aging times make the crystallite size increase and the energy band gap decrease. Photocatalytic activity of samples was examined by measuring rate of methylene blue (MB) decomposition. In photocatalytic process, MB was degraded by photocatalytic and adsorption processes. Aging temperature and time were significant in terms of the MB decolorization ability. The optimal synthesis condition of temperature and aging time was obtained at about 130°C and 16 h, respectively. TiO_2 nanopowder prepared in the previous step was deposited by the spin-coating method on a glass substrate. Self-cleaning properties of the glass substrate coated with TiO_2 nanoparticles were studied by measuring the water contact angle. TiO_2 thin films have little photocatalytic activity because of their low area. To overcome this disadvantage, TiO_2 porous thin films were deposited on glass substrates using polyethylene glycol (PEG) as a template pore- generating agent. TiO2 thin film with 20 wt.% PEG showed better hydrophilic property and a better self-cleaning property. Enhancement of surface wettability due to UV-induced TiO_2 hydrophilicity has been evidenced by contact angle measurements. Keywords: anatase TiO2 nanoparticles, photocatalytic, self-cleaning, contact angle, polyethylene glycol

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