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Thesis Title : Photocatalytic Activity and Photoinduced Superhydrophilicity of Immobilized Nano-TiO_2 Thin Films

Thesis Outline

This thesis investigated the photocatalytic activity and photoinduced superhydrophilicity of nano-TiO_2 thin films immobilized onto glass substrates. Two types of TiO_2 thin films were considered in this research. The first type was TiO_2 thin films immobilized on glass substrates with the aid of surfactants. The thin films were prepared using sol-gel process and immobilized by dip coating technique. Ionic (CTAB) and non-ionic (Triton X-100) surfactants were added to the TiO_2 sol prior to film deposition. The second type of TiO_2 thin films that were studied in this research were Fe-TiO_2 thin films that were prepared in three forms; TiO_2 film doped with Fe(III) ions, TiO_2 film grafted with Fe(III) ions and lastly, TiO_2 film that were doped and grafted with Fe(III) ions. The films were also immobilized onto glass slides coated with SiO_2 and deposited several times to vary the film thickness.

The thin films were characterized using high magnification imaging by field emission scanning electron microscopy (FE-SEM) to see the surface morphology and obtain the film thickness; differential thermal gravimetric analysis (TG-DTA) to determine the transformation and changes the thin films undergo at elevated temperatures; and x-ray diffraction (XRD) to determine the crystal phase of the deposited TiO_2 film. Additional XPS and transmittance plot studies were done for the Fe-TiO_2 films. All of the TiO_2 thin films were evaluated based on their performance in two functionalities namely; (i) photocatalytic activity, which was tested in methylene blue dye degradation in UV light and (ii) photoinduced hydrophilicity of the TiO_2 thin which was evaluated through contact angle measurements after the films were exposed to UV light. Kinetic studies showed that the three and six-layer films followed the Langmuir-Hinshelwood kinetic model.

Results in the first part of the study showed that the addition of surfactants improved the photocatalytic activity of TiO_2 thin films and the films became hydrophilic after exposure to ultraviolet light. For Fe-TiO_2 thin films, their photocatalytic activity and surface hydrophilicity under UV light were significantly influenced by the film configuration.

Keywords : Fe-TiO_2 thin films, Surface hydrophilicity, TiO_2 photocatalysis, TiO_2 thin films.