Titanium Dioxide Nanoparticles: Synthesis, Thermal Characterization, and Photocatalytic Applications for Water Pollutant Degradation

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This paper presents the synthesis of sub-nanometer (< 100 nm) titanium dioxide (TiO_2) spheres by a modified sol-gel method using titanium tetrabutoxide as a molecular precursor. The photocatalytic activity of TiO_2 spheres was screened out by measuring its potential to degrade Rodhamine 6G. Thermal properties were characterized by thermal lens spectroscopy (TLS). This photothermal technique is non-destructive and highly sensitive. It is commonly used to study thermo-optical properties of metallic and semiconductor nanofluids. TLS was performed by employing two non-coupled lasers: an Ar^+ laser as an excitation beam and a He-Ne laser as a probe beam. Experimental data fitted the theoretical model and the typical time constant for thermal diffusivity study in liquids with TiO_2 was obtained. This study supports the viability to use nanostructured materials in the liquid heat transfer optimization applied in sewage water pollutants and dye degradation in the textile industry. UV-vis spectroscopy, FTIR (Fourier Transform Infrared Spectroscopy), TEM (Transmission Electron Microscopy), and XRD (X Ray Diffraction) were used as alternative techniques to determine the absorption coefficients and chemical structure, size of nanoparticle dispersion, and crystallinity of the nanoparticles. The importance of this research work was the determination of the thermal parameters of sewage water as an alternative technique for quality control dye degradation in the textile industry.