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A Novel Approach to the Hydrothermal Synthesis of Anatase Titania Nanoparticles and the Photocatalytic Degradation of Rhodamine B

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Abstract: A novel approach was developed for the synthesis of high-dispersed anatase nano-TiO₂ by a hydrothermal process without solvent at 200 °C in 1 h. It was characterized using XRD, TEM, BET and elemental analysis. Nanoparticle-TiO₂ was used as a photocatalyst by considering complete degradation of Rhodamine B (RB) dye. The photocatalytic reaction parameters such as photocatalyst amount, irradiation time and dye concentration were optimized and it was found that 0.125 wt% catalyst in 30 mg/L of RB aqueous solution is adequate for full degradation of RB in 50 min with 770 W/m² irradiation power. Photocatalytic activity of the nanoparticle-TiO₂ was compared with Degussa P-25 at optimum catalysis conditions determined for the nanoparticle-TiO₂. It was concluded that when compared to Degussa P-25, the nanoparticle-TiO₂ can be repeatedly used with increasing photocatalytic activity. The results revealed that the photodegradation of RB proceeds by pseudo first-order reaction kinetics in which the rate constant of the degradation is 0.132 min⁻¹.

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