# Green Synthesis of Black TiO2 Nanoparticles: A Promising Candidate for Solar-Driven Photocatalytic Water Decontamination

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Titanium dioxide (TiO2) photocatalysis is an effective water purification method against rising rates of dye pollution, but the energy-consuming UV light it requires limits large-scale deployment possibilities. If visible light were leveraged, it would substantially reduce costs and energy consumption, allowing sunlight-activated photocatalysis. Black TiO2 has been studied for this purpose, but its synthesis costs due to high pressure and temperature still prevent industrial scaling. This project elucidates a novel method for synthesizing black TiO2 under milder conditions. The procedure reduced synthesis time and temperature by successfully leveraging a synergetic effect between sodium borohydride and ascorbic acid during thermal reduction and a novel direct grinding operation for the solid ingredients to increase reactant surface area. It removed the need for pressurized conditions, mitigating safety concerns. Higher sample yield and reduced energy consumption were additional benefits over existing methods. Scanning Electron Microscopy, X-ray Diffraction, Raman Spectroscopy, and Fourier-Transform Infrared Spectroscopy revealed that the black TiO2 sample was in a novel form not yet reported in literature. UV-visible Spectroscopy quantified its exceptional photocatalytic efficacy, degrading over 96% of methylene blue dye from aqueous solution after 4 hours of visible light exposure, compared to negligible (<10%) dye removal by white TiO2. High-resolution mass spectrometry confirmed that the majority of methylene blue molecules were degraded into their end components (e.g. nitrate and sulfate). Further investigation of this visible-light-activated photocatalytic system will enhance efforts to create cost-efficient and long-lasting solutions for water purification.