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Surface modification of TiO_2 particles with the sono-assisted exfoliation method

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Abstract

This study reported a novel approach to optimize the photocatalytic property of anatase TiO_2 particles by delaminating their outer surface into highly reactive nanosheets via the sono-assisted exfoliation method. To modify the surface, TiO_2 particles were dispersed in aqueous solution of 10 M sodium hydroxide (NaOH) and tetrabutylammonium hydroxide (TBAOH), followed by irradiation with high intensity ultrasonic wave (20 kHz, 150 W/cm^2) for 60 min. The intercalation and exfoliation processes were accelerated with the driving force of the extreme acoustic cavitation leading to the delamination of TiO_2 nanosheets with highly reactive exposed {001} facets from the mother TiO_2 crystals. The presence of TBAOH increased yield of nanosheets formation and stabilized the nanosheet structure. The unique morphology of the surface modified TiO_2 particles provided benefits in increasing the specific surface area and lowering the optical band gap energy (E_g) and electron-hole recombination rate resulting in an enhancement of methylene blue dye degradation efficiency. The surface modification of TiO_2 particles by the sono-assisted exfoliation method can optimize the photocatalytic activity by yielding synergetic effects of the high surface reactive sites of the nanosheets and the high degree of crystallinity of the bulk structure.