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Thermal/plasma treatment effect on photocatalytic degradation of aqueous solution of methylene blue using Au-doped Fe/TiO_2 photocatalyst

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ABSTRACT

The effect of thermal/plasma treatment on the photocatalytic degradation of methylene blue (MB) using Au-doped Fe/TiO_2 photocatalyst was investigated. Iron (Fe)-doped TiO_2 samples were prepared by solgel auto-combustion technique. Later, gold nano-particles (AuNPs) were deposited on the as-prepared support (Fe/TiO_2) using conventional deposition–precipitation method with NaOH (DP NaOH), and the resulting catalysts were subsequently modified with thermal (at 450°C under vacuum) and plasma (at an ambient temperature under Argon atmosphere for 20 min) treatments. To evaluate particle structure, size distribution, and composition, diverse analytical techniques such as X-ray diffractometer, BET surface area, SEM, EDX, and TEM were used. The photocatalytic activity was evaluated by assessing the degradation of the MB in water under ultraviolet (UV) irradiations while the parameters affecting photocatalytic process such as the catalyst crystallinity, light absorption efficiency, the dosage of catalyst, dopant, and MB concentrations were well controlled. Thermal-/plasma-treated samples showed significant enhancement in the photocatalytic activity compared to untreated samples by changing the morphology, increasing the number of AuNPs, improving the Au-doped Fe/TiO_2 interface, and decreasing the band-gap energies thus tuned Au-doped Fe/TiO_2 catalyst to higher efficiency. The AuNPs deposited on the Fe/TiO_2 showed good thermal stability as well. Based on the obtained results, it can be expected that the modified catalyst may have potential applications in various advanced technologies such as water treatment, sustainable energy, clean environment, and several others.

Keywords: Thermal/plasma; Photocatalytic degradation; Au nanoparticles; Fe/TiO_2; Methylene blue

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