Photocatalytic Activity of Fe-doped TiO_2 and ZnO

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Abstract

Photocatalysis has emerged as a promising approach for environmental cleanup and sustainable energy applications due to its ability to utilise semiconductor materials for the degradation of organic pollutants under visible light irradiation. Among the most widely investigated photocatalysts, titanium dioxide (TiO_2) and zinc oxide (ZnO) exhibit excellent chemical stability, low toxicity, and strong photocatalytic potential. However, their practical application is limited by their wide band gaps and rapid recombination of photogenerated electron–hole pairs, which reduces their efficiency under the visible light. This seminar reviews the theoretical background of TiO_2 and ZnO photocatalysts, focusing on how iron incorporation (Fe doping) can modify their structural and electronic properties to enhance their photocatalytic activity. The role of Fe doping in the improving of charge separation, extending visible-light absorption, and influencing crystallinity and defect formation is discussed based on the current literature. On top of that, this seminar presents the planned experimental methodology, using our available experimental infrastructure, on synthesis of doped materials, such as the Atomic Layer Deposition (ALD) and their characterisation using X-ray Diffraction (XRD), Secondary Ion Mass Spectrometry (SIMS), Scanning Electron Microscopy coupled with Energy-Dispersive X-ray Spectroscopy (SEM/EDS), and UV–Vis Spectroscopy to test the photocatalytic activity of our synthesised materials. Rather than presenting experimental results, this work establishes the theoretical framework and research direction for future investigations aimed at optimising the photocatalytic activity of TiO_2 and ZnO through controlled synthesis and comprehensive material characterisation.

Keywords

Photocatalysis, titanium dioxide, zinc oxide, iron doping, semiconductors