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Facile solid-state synthesis of heterojunction CeO_2/TiO_2 nanocomposite as an efficient photocatalyst for the degradation of organic pollutants

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ABSTRACT

In this study, CeO_2/TiO_2 nanocomposites (NCs) were synthesized by adopting a straightforward two steps method comprising, first, the synthesis of CeO_2 and TiO_2 nanoparticles by wet chemical precipitation method and second, the heterostructure CeO_2/TiO_2 NCs by solid-state reaction process. The CeO_2/TiO_2 NCs were characterized by X-ray diffraction, N_2 adsorption–desorption isotherm analysis, field emission scanning electron microscopy, energy-dispersive X-ray spectroscopy, and UV-vis diffuse reflectance spectroscopy. Regardless of CeO_2 content, the bandgap energies of CeO_2/TiO_2 NCs were lower than that of pure TiO_2. Photocatalytic activity of the synthesized photocatalysts was assessed by degrading a model dye methylene blue under the illumination of UV light. The CeO_2/TiO_2 NCs containing 2 wt% CeO_2 exhibited higher photocatalytic degradation efficiency compared to reference TiO_2 (P25), pure TiO_2, and CeO_2/TiO_2 NCs containing CeO_2 other than 2 wt%. The alkaline environment was favorable for photocatalytic decomposition of cationic dye methylene blue (MB). The enhanced degradation efficiency of CeO_2/TiO_2 NCs was substantiated in terms of vectorial charge separation and the reduction of photogenerated charge carriers owing to the band offsets existing at the interface between CeO_2 and TiO_2 NPs. Finally, no significant change in the degradation efficiency of CeO_2/TiO_2 NCs after successive uses evidenced the stability and reusability of the photocatalysts. Therefore, it can be concluded that the synthesized CeO_2/TiO_2 heterostructure photocatalyst would be a promising candidate for application in wastewater treatment.

Keywords: Solid state synthesis; CeO_2/TiO_2 nanocomposites; Heterojunction photocatalyst; Degradation efficiency; Band offset

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