Quaternized zinc(II) phthalocyanine-sensitized TiO₂: surfactant-modified sol–gel synthesis, characterization and photocatalytic applications

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ABSTRACT

TiO₂ nanoparticles and zinc phthalocyanine-sensitized TiO₂ (ZnPc/TiO₂) nanocomposite were synthesized in the presence and absence of Triton X100 (a nonionic surfactant) by a modified sol–gel method to improve the photocatalytic activity of TiO₂ under near visible light (365 nm). A novel quaternized ZnPc molecule was used as sensitizer. Prepared nanoparticles and nanocomposite were characterized by scanning electron microscopy, energy dispersive analysis, X-ray diffractometry, transmission electron microscopy (TEM), Brunauer–Emmett–Teller, thermogravimetry analysis, and UV–vis–NIR. The results demonstrated that the ZnPc was successfully loaded on the TiO₂ nanoparticles and the nanocomposite possesses the anatase crystalline phase with the specific surface area of 110.04 m² g⁻¹. The TEM micrograph showed that the average grain crystal size is 5–15 nm. ZnPc in the TiO₂ structure shifted the absorption edge to visible region. The photocatalytic activities of prepared photocatalysts (ZnPc/TiO₂, ZnPc/TiO₂-TX100, TiO₂, and TiO₂-TX100) were evaluated for degradative removal of methyl orange and reductive removal of Cr(VI) ions as test pollutants. Results of photocatalytic removal revealed that the ZnPc/TiO₂-TX100 has shown much more photocatalytic efficiencies than the ZnPc/TiO₂ prepared without TX100 and neat TiO₂ prepared with or without TX100. Therefore, this sol–gel method modified with TX100 is useful in the preparation of nanostructure ZnPc/TiO₂ with high photocatalytic activity and higher surface area.

Keywords: Zinc phthalocyanine; Sensitization; TiO₂; Photocatalytic activity; Surfactant

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