

[← Back](#)

Sol-gel method synthesized Ce-doped TiO₂ visible light photocatalyst for degradation of organic pollutants

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Abstract

The Ce-doped TiO₂ nanoparticles were prepared by the sol-gel method. The prepared nanoparticles were characterized by sophisticated analytical techniques such as XRD, FESEM with EDX, HR-TEM, XPS, FTIR, TGA, and UV-visible spectroscopy, which gives structural features, morphology, elemental composition, and thermal stability of prepared nanoparticles. Based on the analysis, we conclude that increasing the dopant content of cerium in TiO₂ results in a decrease in particle size, increase in thermal stability, and decrease in band gap. Further, on increasing the dopant content of cerium, there is an increase in photocatalytic activity due to changes in structural features due to doping, and 5 mol% Ce-doped TiO₂ has shown nearly four times higher photocatalytic activity than pure TiO₂ for degradation of tetracycline. In this study, the photocatalytic activity and kinetics of photocatalytic degradation of antibacterial agent tetracycline have been studied by using these prepared catalysts. Further, effects of different parameters such as change in pH and change in concentration of tetracycline and amount of catalyst loading have been studied for the degradation of tetracycline. Also, Ce-doped TiO₂ has shown good photocatalytic efficiency for degradation of a mixture of textile dyes (methylene blue, rhodamine B, and brilliant green) and for degradation of a mixture of emerging contaminants (tetracycline, diclofenac, and triclosan).

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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DATA AVAILABILITY STATEMENT

[Back](#)

Supporting Information

Filename	Description
aoc6586-sup-0001-Supporting information.docx Word 2007 document , 2.4 MB	FIGURE S1. FESEM images of pure TiO ₂ (a), 1 mol% Ce-doped TiO ₂ (b), 3 mol% Ce-doped TiO ₂ (c and d) and 5 mol% Ce-doped (e and f) nanoparticles. Figure S2. HRTEM images of 5 mol% Ce-doped TiO ₂ nanoparticles. Figure S3. Plot of absorbance against wavelength of Photocatalytic degradation of Mixture (MB, BG and RB) by a) TiO ₂ b) 1 mol% Ce-doped TiO ₂ and c) 3 mol% Ce-doped TiO ₂ nanoparticles.

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