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研究论文

Preparation and Characterization of High Activity Zirconium-Doped Anatase Titania for Solar Photocatalytic Degradation of Ethidium Bromide

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摘要 Ethidium bromide is a fluorescent tag and is used in biomedical applications. It is a potent mutagen because of its DNA intercalating nature. A catalyst composition for the feasible elimination of ethidium bromide using a broad spectrum of solar radiation was investigated. Nanostructured anatase TiO_2 was synthesized by gel to crystalline conversion and its bandgap was engineered by doping with zirconium to effectively harness sunlight. The doped nanocrystals were characterized by X-ray diffraction, scanning electron microscopy, transmission electron microscopy, energy dispersive X-ray analysis, and UV-Vis spectroscopy. The formed crystals retained the anatase phase with a marginal increase in size. The pulverization process used to dope Zr into titania resulted in a nano and doped lattice with an increased and extended light absorption range, which gave a nearly five-fold increase in photoactivity over pure titania. The catalytic effect of the modified titania, the dopant concentration, and the dynamics of the dopant concentration on the charge carriers (trapping-recombination) for the degradation of the mutagen was investigated. The modified titania is capable of total ethidium bromide elimination in sunlight. The loss of its mutagenic property was confirmed by an Ames test. The induced revertant colonies observed were nil in the treated sample indicating a complete loss of the intercalating property of the mutagen.

关键词： sunlight titania zirconium ethidium bromide elimination

Abstract： Ethidium bromide is a fluorescent tag and is used in biomedical applications. It is a potent mutagen because of its DNA intercalating nature. A catalyst composition for the feasible elimination of ethidium bromide using a broad spectrum of solar radiation was investigated. Nanostructured anatase TiO_2 was synthesized by gel to crystalline conversion and its bandgap was engineered by doping with zirconium to effectively harness sunlight. The doped nanocrystals were characterized by X-ray diffraction, scanning electron microscopy, transmission electron microscopy, energy dispersive X-ray analysis, and UV-Vis spectroscopy. The formed crystals retained the anatase phase with a marginal increase in size. The pulverization process used to dope Zr into titania resulted in a nano and doped lattice with an increased and extended light absorption range, which gave a nearly five-fold increase in photoactivity over pure titania. The catalytic effect of the modified titania, the dopant concentration, and the dynamics of the dopant concentration on the charge carriers (trapping-recombination) for the degradation of the mutagen was investigated. The modified titania is capable of total ethidium bromide elimination in sunlight. The loss of its mutagenic property was confirmed by an Ames test. The induced revertant colonies observed were nil in the treated sample indicating a complete loss of the intercalating property of the mutagen.

Keywords： sunlight, titania, zirconium, ethidium bromide, elimination

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