

主 論 文 要 旨

2010年12月22日

論文題名

Preparation of Au-TiO₂ Nanocomposite Photocatalytic Film by Sol-Gel Method

ふりがな ちひろ よぎ

学位申請者 Chihiro Yogi

主論文要旨

A spectral analysis method for a demethylated reaction of methylene blue (MB) in the photocatalytic degradation reaction of MB aqueous solution was proposed. Absorption spectra near maximum absorption peaks in temporal spectral changes of MB solution degraded by a TiO₂ film were deconvoluted into the spectra of MB-related dyes (MB and demethylated species) using Beer-Lambert's law and Gauss-Jordan method. Molar concentration of each dye was estimated from the obtained absorbance of each peak, followed by calculating the molar concentration changes of MB-related dyes in the photodegraded MB solution. Additionally, the analysis of the photodegraded MB solution revealed the formation of *N*'-dimethylthionin in the demethylated reaction. Furthermore, HPLC and ¹H-NMR analyses of commercial MB-related dyes were performed and their purity was discussed. Absorption spectra of pure MB-related dyes were obtained for the first time.

Au particles deposited TiO₂ (Au/TiO₂) film was prepared using the sol-gel and photodeposition methods. When a photocatalytic activity was evaluated using an MB solution under aerobic condition, the activity of the Au/TiO₂ film was found to be improved. On the other hand, under anaerobic condition, it was cleared that Au particle worked as a trap of photo-generated electron since a formation of LMB (direduced form of MB) was observed in absorption spectral changes of an MB solution degraded by the Au/TiO₂ film, resulting in an enhancement of charge separation rate in the film which leads to an improvement of the photocatalytic activity under aerobic condition.

Au nanoparticles (AuNPs) embedded TiO₂ film was synthesized by coating a polyvinylpyrrolidone-protected AuNPs-dispersed TiO₂ sol solution on a silica glass substrate. Mean diameter of AuNPs used was 2.0±0.7 or 7.9±3.1 nm. The study of the influence of AuNPs size on TiO₂ phase revealed that small AuNPs of 2.0 nm promoted the crystallinity of anatase TiO₂ and large ones of 7.9 nm suppressed the anatase-rutile phase transformation effectively. Furthermore, the photocatalytic activity of the small AuNPs-embedded TiO₂ film annealed at 500 °C was the highest among the prepared films, and Ti *K*-edge XANES measurement showed that this film possessed much more five-coordinated Ti site known to an active site.