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Visible-light active TiO_2 photocatalysis fabricated by mechanochemical method

○Shintaro Takahashi[1], Tomoji Wakamiya[1], Ken-ichi Saitow[1,2]
[1] Grad.Sc. Sci., HiroshimaUniv.[2] N-BARD, HiroshimaUniv.

Titanium dioxide (TiO_2) as a semiconductor material when irradiated with a photon energy greater than the band gap energy (3.2 eV) generates electrons in the conduction band and holes in the valence band. The electrons and holes generated can cause reduction and oxidation reactions, respectively, against molecules adsorbed onto the TiO_2 surface. This phenomenon has been recognized as photocatalysis [1], and thus, TiO_2 is used as a material for the degradation of organic pollutants, self-cleaning surfaces, water-splitting, and fabrication of photovoltaic cells. Since the TiO_2 photocatalysis is driven by the UV-light irradiation at the wavelength shorter than 388 nm, the visible-light active TiO_2 has been desired. This is because the peak wavelength of the sunlight as well as an indoor lighting is located in the visible region ($\lambda \cong 500$ nm). To obtain the visible absorption of TiO_2, there is a method for doping the nitrogen atoms into the TiO_2 [2].

Here, we show the fabrication of N-doped TiO_2 particles by a planetary ball milling method. The absorption spectra and the photocatalytic activity were investigated by changing milling time or revolution speed. The photocatalytic activity was evaluated by the decomposition reaction of methylene blue (MB) molecules dissolved in water. As a result, it was elucidated that the N-doped TiO_2 has absorption in the visible region, ranging from 400 to 550 nm. The absorbance increased as milling time and revolution speed increase. The N-doped TiO_2 caused the decomposition reaction of the MB by irradiating the visible light of $\lambda = 450$ or 500 nm. The photocatalytic activity at the irradiation of 450 nm was better than that of 500 nm.

References

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