

# A Study of Reaction Parameters and Catalytic Properties in Photo-decomposition of Acetaldehyde over In, P doped TiO<sub>2</sub>

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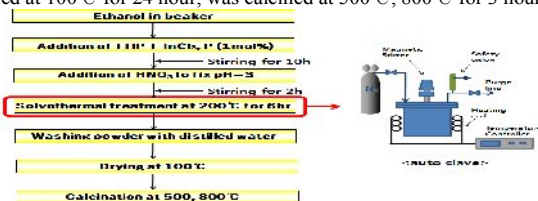
## Introduction

Volatile organic compounds (VOCs) are hazardous pollutants emitted from paints, solvents, reservatives, automobile exhaust gas, industrial facilities, and etc. (Jones, 1999; Wargocki et al., 2002; Wolkoff and Nielsen, 2001; Fanger, 2001; Racciatti et al., 2001). Now, most of the small emission sources of VOCs take no effective environmental measures. Recently, VOCs are recognized as causative agents of the sick-building syndrome. Therefore, it is considered that effluent controls at the VOCs emission sources will be severe all over the world[1].

In this study, three photo-catalysts (In, P and In-P incorporated into TiO<sub>2</sub> at 1.0 mol%) were prepared using a hydrothermal method. The physical properties of the photo-catalysts were characterized using XRD, XPS, and the optical properties were characterized using UV-visible spectrometer, Photo-luminescence spectrometer. The removal of acetaldehyde was conducted in continuous photocatalytic system. The certain correlations are between the activity and characterization[2,4].

## Materials and Methods

The In, P, and In-P incorporated TiO<sub>2</sub> were prepared using a hydrothermal method, as shown in Fig. 1. To prepare the sol mixture, titanium tetraisopropoxide, TTIP (99.95%, Junsei Chemical, Tokyo, Japan), (InCl<sub>3</sub>, 98%, Aldrich, USA), H<sub>3</sub>PO<sub>4</sub> (Wako, Japan) were used as the titanium, indium, phosphorus precursors, respectively, with ethanol used as the solvent. To depress the coagulation caused by rapid hydrolysis, acetic acid was added to 200ml of ethanol, with the pH maintained 3.0, 1.0 mol TTIP and one of the 1.0 mol% metal precursors added stepwise, and then homogeneously stirred. The TTIP and metal chlorides were hydrolyzed via the OH group during thermal treatment at 200 °C for 6 hour approximate 10.0 atm under a nitrogen environment. The precipitate was washed until a pH of 7.0 was attained, and then dried at 100 °C for 24 hour, was calcined at 500 °C, 800 °C for 3 hour[3].

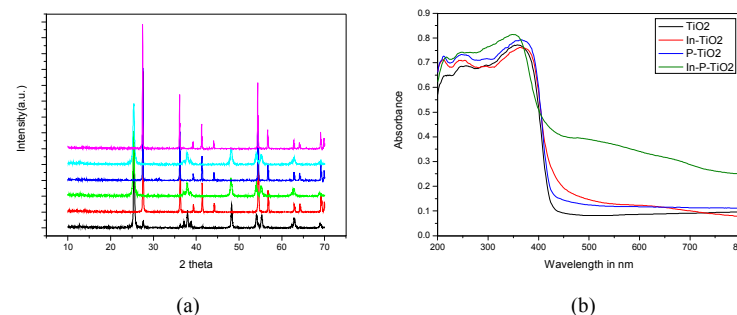


**Figure 1.** Photocatalysts preparation produce by Solvothermal method (a) Solvothermal method, (b) Autoclave used.

## Results and Discussion

Fig. 2 (a) shows the XRD patterns of the 1.0 mol% In, P, and InP incorporated TiO<sub>2</sub> photocatalysts treated at 500 and 800 °C. The diffraction peaks for the anatase and rutile phases are labeled “A” and “R”, respectively, with the corresponding diffraction planes given in parentheses. All prepared catalysts showed well-developed anatase and rutile structure after treatment at 500 and 800 °C. Generally, the broader the peak, the smaller are the crystallites. The spectral peaks assigned to the additive materials did not appear in any of the samples, indicating that the In, Sn, and Sb metal ions were satisfactorily inserted into the TiO<sub>2</sub> framework.

Fig. 2 (b) shows the UV-vis spectra of the TiO<sub>2</sub> and In, P, and InP 1.0 mol% incorporated TiO<sub>2</sub> powders. The absorption for the tetrahedral symmetry of Ti4+ normally appears at around 350 nm. In this study, an absorption band was observed at around 380 nm for pure TiO<sub>2</sub> synthesized using the hydrothermal method. In the In-P-TiO<sub>2</sub>, the absorption band is shifted to a higher wavelength than in P-TiO<sub>2</sub>, In-TiO<sub>2</sub>. Specially, the In-P-TiO<sub>2</sub> photocatalysts absorbed visible ray wavelengths from 400nm to 800nm. The broad band from 400 to 800 nm might have resulted because the In-P co-component was on the external surface of the rutile In-P-TiO<sub>2</sub>, as shown in the XRD result.



**Figure 2.** (a) XRD patterns and (b)UV-vis spectra of TiO<sub>2</sub>, In-TiO<sub>2</sub>, P-TiO<sub>2</sub>, In-P-TiO<sub>2</sub>.

## References

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