PA49) Synthesis and Characterization of N-doped ZrO_2/TiO_2 Nanoparticles with Enhanced Photocatalytic Activity and Evaluation of Photodegradation of NOx under Visible-light

Ji-Young Kim · Chan-Soo Kim[1] · Tae-Oh Kim
Department of Environmental engineering, Kumoh National Institute of Technology,
[1]Department of Materials Science and Engineering, Seoul National University

1. Introduction

TiO_2 has been widely used as an efficient photocatalyst for the photogradation of organic pollutants in water owing to its low cost, strong oxidizing power, non-toxicity and long-term photostability (Tian et al., 2009). However, the drawback of cationic doopants is that they generally have weak absorption in the visible-light range. One of studies was the doping of TiO_2 with transition-metal elements as ZrO_2 (Neppolian et al., 2007). Nevertheless, the disadvantage of cationic dopants is that they often show a weak absorption in the visible-light. To further advance efficient utilization of solar energy, non-metal doping of TiO_2 has been carried out to prepare a visible-light sensitive photocatalyst via band gap reduction of the photocatalyst (Asahi et al., 2001).

2. Experiment

ZnO_2 and nitrogen added TiO_2 powder was synthesized by a polymer complex solution method (PCSM). The sample was calcined at 500℃ and characterized by XRD, BET, TEM, XPS, FT-IR and UV-vis spectrophotometer. The photocatalytic of prepared catalysts was evaluated by the decomposition of NOx under UV, visible light.

3. Result and Discussion

Figure 1 shows the FTIR spectra. Two peaks at 1631 and 3423cm^{-1} are assigned to the OH groups. Obviously, the intensity of the two peaks in N-doped ZrO_2/TiO_2 sample is much stronger than without zirconia, nitrogen. The surface acidity in the form of OH groups enhanced photocatalytic activity in N-doped ZrO_2/TiO_2 sample.

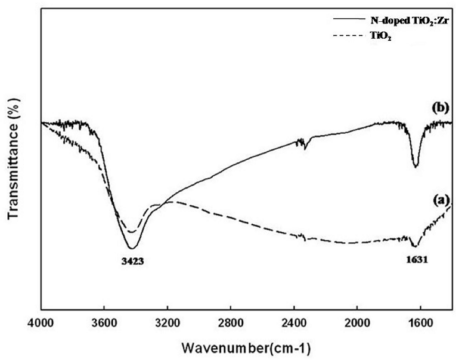

Fig. 1. FTIR spectra of (a) TiO_2 and (b) N-doped TiO_2/ZrO_2 samples.

The photocatalytic activity of N-doped TiO_2/ZrO_2 sample was evaluated by measuring the degradation rate of NOx under UV and visible light as shown in Figure 2. The photocatalytic behavior of Degussa P25 was also measured as a reference. The degradation of NOx of N-doped TiO_2/ZrO_2 sample and Degussa P25 is 96.2% and 18.2% for UV light (a) and 71.0% and 4.0% for visible light (b), respectively.

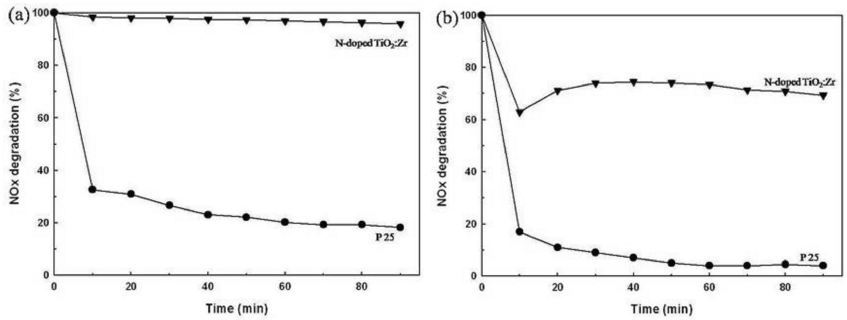

Fig. 2. Degradation rate of NOx under (a) UV light and (b) visible light of P25 (●) and N-doped TiO_2/ZrO_2 (▼) samples.

References

Asahi, R., T. Morikawa, T. Ohwaki, K. Aoki, and Y. Taga (2001) Visible-light Photocatalysis in Nitrogen-Doped Titanium Oxides, Science, 293, 269-271.

Neppolian, B., Q. Wang, H. Yamashita, and H. Choi (2007) Synthesis and characterization of ZrO_2-TiO_2 binary oxide semiconductor nanoparticles: Application and interparticle electron transfer process, Appl. Catal. A: General, 333, 264-271.

Tian, G., K. Pan, H. Fu, L. Jing, and W. Zhou (2009) Enhanced photocatalytic activity of S-doped TiO_2-ZrO_2 nanoparticles under visible-light irradiation, J. Hazar. Mater., 166. 939-944.