INVITED LECTURE 4

Improving Activity of Commercial P25 Titanium Dioxide Photocatalyst

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ABSTRACT

Titanium dioxide (TiO_2) is recognized as one of the most active photocatalysts for degradation of organic pollutants. Among the available commercial TiO_2, particular attention is focused on the P25 TiO_2 having a mixture of anatase-rutile phases and act as the benchmark for the TiO_2 photocatalysts. While numerous studies have been reported on the high activity of the P25 TiO_2 for degradation of organic pollutants, improving the activity of the P25 TiO_2 remained as a great challenge. On the other hand, impregnation method has been used conventionally to introduce metal oxide on the photocatalyst. This method is usually followed by calcination at high temperature to convert the metal precursor to metal oxide. Controversial results have been reported on the activity of P25 TiO_2 after calcination process. It was reported that the calcined P25 TiO_2 at 773 K showed two times higher activity than the untreated one for decolorization of methyl orange [1]. In contrast, the activity of P25 TiO_2 was found to decrease with the increase of the calcination temperatures for decomposition and reduction reactions of NO [2], photodegradation of light hydrocarbons mixture [3] and butanol [4]. In the present study, the effect of calcination temperatures on the activity of P25 TiO_2 was examined for photocatalytic removal of 2,4-dichlorophenoxyacetic acid (2,4-D) as the model of organic pollutants. The activity of the P25 TiO_2 was slightly improved when the photocatalyst was calcined at 573 K, but decreased when calcined at 773 K. The P25 TiO_2 were further modified by different metal oxides, *i.e.*, copper oxide, cobalt oxide, and lanthanum oxide by impregnation method, followed by calcination at 773 K. All the series gave similar results; 1) addition of the metal oxides did not affect much the crystallinity, phase composition, and morphology of the P25 TiO_2, 2) only small amount of added metal oxide (*ca*. 0.1-0.5 mol%) led to the improved photocatalytic activity, while addition of high loading amount decreased the activity of P25 TiO_2, 3) the increased photocatalytic activity might be due to the ability of added metal oxide to suppress the charge recombination without blocking the active sites of the P25 TiO_2. Among the investigated series and under the same reaction conditions, the La(0.1 mol%)/P25 TiO_2 gave the highest photocatalytic activity for the removal of 2,4-D. After 1 hour reaction, the La(0.1 mol%)/P25 TiO_2 gave ca. 1.25 times higher photocatalytic activity than the unmodified P25 TiO_2 [5].