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Catalysis between innovation and tradition: new challenges and new opportunities for University and Industry

Doped Titania photocatalysts for NO_x abatement

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TiO_2 is the most used photocatalyst for solar energy conversion and environmental applications, because of its good photoactivity, high chemical stability in the reaction condition, low cost and non-toxicity. Unfortunately, due to its large band gap (3.2eV), the light sources for photocatalytic reactions in these applications are limited to sunlight, which included only 2-3% ultraviolet. Therefore, considerable efforts have been addressed to expand the optical response of TiO_2 from the UV to the visible light region. It's common knowledge that the introduction of transition metal ions such as V, W, Fe into the titanium oxide, or its modification with nonmetal atoms, (S, C , N), promotes the decrease of the bad gap energy[1].

In order to extend the absorption wavelenght range into the visible light region, in the present work we report the synthesis, characterization and reactivity of a number of TiO_2 undoped and doped with N and C samples. The photocatalytic abatement of NOx has been used as test reaction.

All samples were prepared using titanium oxysulfate as TiO_2 precursor. N were introduced by addition of NH_3 as precipitation agent and organic carbon compounds were introduced by thermal decomposition using succinic acid[2]. The activity of our samples were compared with pure TiO_2 and one commercial C-doped TiO_2 catalyst.

All catalysts were characterized by N_2 physisorption measurements, elementary analyses and temperature programmed analyses (TPO). N_2 physisorption analyses show that the surface areas of the new N,C-doped titania samples are significantly higher than no-doped TiO_2. Elementary analyses confirm the presence of nitrogen and a high carbon content in our samples.

The photocatalytic activities of pure and doped-TiO_2 samples were analysed by NO oxidation reaction in the visible light region using a lab made plant equipped with a chemiluminescence analyzer.

Our doped samples have shown an improved activity in comparison with pure TiO_2 in the experimental conditions. In particular, a significant increase of the photocatalytic activity has been obtained for the samples doped with both C and N. Further improvements can be obtained by a careful optimization of C and N amounts. The specific role of the dopants will be discussed.

References

[1] Journal: X.Yang, C.Cao, L.Erickson, K.Hohn, R.Maghirang, K.Klabunde, *J. Catal,*260 (2008) 128.

[2] Patent: Orth-Gerber, Jurgen et al., *US 20050226761* (2005)