Chinese Chemical Letters Vol. 12, No. 6, pp. 549 – 550, 2001

Photocatalytic Characterization of TiO_2 Supported on Active Carbon

Xue Ping LI*, Feng YIN, Yuan LIN, Jing Bo ZHANG, Xu Rui XIAO

Laboratory of Photochemistry, Center for Molecular Sciences, Institute of Chemistry,Chinese Academy of Sciences, Beijing 100080

Absract: The Photocatalytic characterization of TiO_2 supported on active carbon was investigated for photocatalytic decomposition of dichloroacetic acid. It was found that TiO_2 / AC exhibited a higher photocatalytic activity than pure TiO_2. The reason is that active carbon acting as powerful adsorbent supports makes high concentration environments of organic pollutant molecules around TiO_2 particles.

Keywords: Photocatalysis, TiO_2, active carbon.

Photocatalysis on TiO_2, with a promising application to the elimination of organic contaminants from air and water, has been a particularly active area[1]. For such application, it is important to improve the efficiency of TiO_2 photocatalysts. In the most cases, the concentration of organic contaminants in water is extremely dilute (ppm level or below) and TiO_2 itself has low adsorbabilities for them, it usually takes a long time to complete their decomposition. One of the effective ways to increase the photocatalytic efficiency is the use of inert adsorbents with high surface area and porosity as supports for TiO_2[2]. In this study, we deal with the effect of active carbon as a support on the photocatalytic decomposition of dichloroacetic acid (DCA).

TiO_2 photocatalysts supported on the active carbon (TiO_2 / AC) were prepared by mixing active carbon powder with TiO_2 sol obtained by the hydrolysis of titanium n-butoxide in acidified water. The photocatalysts (TiO_2 or TiO_2 / AC) were placed in a Pryex cell with an aqueous solution of DCA (1.25×10^{-4} mol/L.) and irradiated using UV light from high pressure Hg lamp.

Figure 1 shows the change of Cl^- concentration produced in photodecom-position of DCA aqueous solution with irradiation time. As shown in the **Figure**, the photocatalytic activity for TiO_2/AC was higher than that for pure TiO_2. The complete decomposition of DCA is given by

$$Cl_2CHCOOH + O_2 \longrightarrow 2CO_2 + 2HCl \qquad (1)$$

If the photocatalytic decomposition of DCA to produce Cl^- follows the pseudo -first-order kinetics, the rate of Cl^- production at a given time is given by Eq. (2)

Figure 1 Change of $[Cl^-]$ *vs.* time

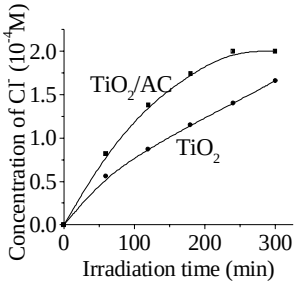
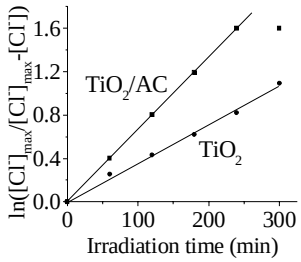


Figure 2 Linear transform of curves of **Figure1**



$$\ln \frac{[Cl^-]_{max}}{[Cl^-]_{max} - [Cl^-]} = K_{Cl^-} \cdot t \qquad (2)$$

Where K_{Cl}^- is the apparent constant for Cl^- production. $[Cl^-]_{max}$ is the Cl^- concentration expected from complete photodecomposition of DCA, and $[Cl^-]$ is that obtained at given irradiation time. Plots of left hand side of Eq.2 with Cl^- concentration given in **Figure 1** as a function of the irradiation time give fairly good linear relation as shown in **Figure 2**. The rate constant of Cl^- production, K_{Cl}^- determined from the slope of the curve was listed in **Table 1**. It was very clear that supporting TiO_2 on active carbon can significantly enhance the rate of photocatalytic decomposition of DCA. Because as TiO_2 was supported on active carbon the specific surface area of the photocatalysts and their adsorbability for organic molecules can be increased, providing high concentration environments of organic molecules around TiO_2 particles. The adsorption experiments of DCA have proved that the adsorbed amount of DCA on TiO_2 / AC was larger than that on TiO_2.

Table 1 The data of K_{Cl}^- for photocatalytic decomposition of DCA

Catalyst	TiO_2	TiO_2 /AC
$K_{Cl}^-(min^{-1})$	3.45×10^{-3}	6.65×10^{-3}

Acknowledgments

This work was supported by the National Natural Science Foundation of China (No.29877025).

References

1. M. R. Hoffmann, S. T. Martin, W. Choi, D. W. Bahnemann, *Chem. Rev.*, **1995**, *95*, 69.
2. T.Torimoto, S.Kuwabata, H.Yoneyama, *Environ. Sci. Technol.*, **1996**, *30*, 1275.

Received 15 November, 2000