P79 Photocatalytic Activities for Rutile TiO_2 Photocatalysts as Studied by ^1H NMR Spectroscopy

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TiO_2 photocatalysts exhibit useful characteristics such as high oxidation power for the degradation of harmful organic compounds in air and water and photoinduced highly hydrophilic surface. Various kinds of TiO_2 photocatalysts have been developed and utilized practically in many fields, especially for environmental cleanup. The functions are closely related to the surface structures and the properties of water adsorbed on the TiO_2 solid surface. The functions are caused mostly by the exertion of the active species produced through the reactions of photogenerated electrons and holes with adsorbed water or titanol on TiO_2. For the better understanding of individual photocatalytic functions and improvement of the photocatalytic efficiency, it is inevitable to elucidate the structures and properties of the adsorbed water related to the photocatalytic activity. Hence, we have been studying the properties of adsorbed water and the related photocatalytic activities for various anatase abundant TiO_2 photocatalysts with different characteristics mainly by ^1H NMR spectroscopy [1-6]. For the anatase abundant TiO_2 photocatalysts, the physisorbed water region could be described as three water layers [4, 5]. The photocatalytic decomposition of benzoic acid with an aromatic ring was much faster in all the TiO_2 aqueous suspensions and more enhanced for the fully dehydroxylated TiO_2 than that of acetic acid, suggesting that the most efficient photocatalytic sites should be the hydrophobic sites on the TiO_2 surface [6].

In this study we investigated properties of adsorbed water and photocatalytic decomposition for four kinds of rutile TiO_2 photocatalysts with different characteristics and compared with those for anatase abundant TiO_2 photocatalysts. The results indicated that the physisorbed water region on the rutile TiO_2 photocatalysts could be described by two layers, different from anatase abundant TiO_2 photocatalysts. The photocatalytic decomposition rates of acetic acid and benzoic acid were distinctively different among the four different rutile TiO_2 photocatalysts. The correlation of photocatalytic activities with the adsorbed water and the surface structures for the rutile TiO_2 photocatalysts will be discussed.

References

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