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HYDROXYL RADICALS IN SEMICONDUCTOR PHOTOCATALYSIS

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ABSTRACT

Semiconductor photocatalysis has been recognized useful owing to the prominent functions on environmental cleaning and expected to be practically applied for the solar fuel production. Hydroxyl radical (•OH) has been believed to play a role of the key reactant in photocatalysis. However, no direct evidence of the presence of •OH has been presented. In gas phase we could confirm the presence of •OH as the finger print of rotational spectra using a laser-induced fluorescence spectroscopy technique. On the other hand, in aqueous solution the direct detection of •OH has been difficult. Recently, the fluorescence probe method was found to be convenient and could be applied to various reaction systems. To understand the reaction of •OH in detail at the surface of photocatalyst, electrochemical analysis of the irradiated semiconductors was attempted by a fluorescence probe method. For the single crystal rutile TiO_2 electrodes, the facet dependence on the •OH formation could be observed along with oxygen evolution by the photooxidation of water. Besides the UV responsive TiO₂, widely noticed visible-light-responsive photocatalysts, such as narrow bandgap BiVO₄ and plasmon sensitized Au/TiO₂, were also examined. Thus, we reviewed the detection procedures and the contribution of •OH in the reactions of the BiVO₄ and TiO₂ photoelectrodes, and the TiO₂ and Au/TiO₂ photocatalysts. As a result, the amount of •OH formed in the photocatalysis was found to be very small, and then the contribution in the oxidation reaction is not significant.

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