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New Heterogeneous Photocatalysts Designed for Water Oxidation and CO_2 Reduction

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Abstract

Water splitting and CO_2 fixation on heterogeneous photocatalysts are importance reactions from the viewpoint of solar-to-fuel energy conversion. To achieve these reactions, it is important to improve both bulk and surface properties of a photocatalyst so as to suppress electron–hole recombination and promote surface redox catalysis. In this presentation, recent progress on the development of new photocatalysts that are active for such artificial photosynthetic reactions will be given. In particular, surface modification techniques developed by our group to construct active sites and light-absorbing centers will be presented. For example, we developed a new powdered photocatalyst consisting of $Co(OH)_2$ and TiO_2 [1]. It is well known that TiO_2 is an active photocatalyst, but only works under UV irradiation. By contrast, the $Co(OH)_2/TiO_2$ hybrid photocatalyst is capable of absorbing visible light with wavelengths of up to 850 nm and oxidizing water into oxygen gas, even though it consists of only earth-abundant elements only. To our knowledge, this system provides the first demonstration of a photocatalytic material capable of water oxidation upon excitation by visible light up to such a long wavelength.

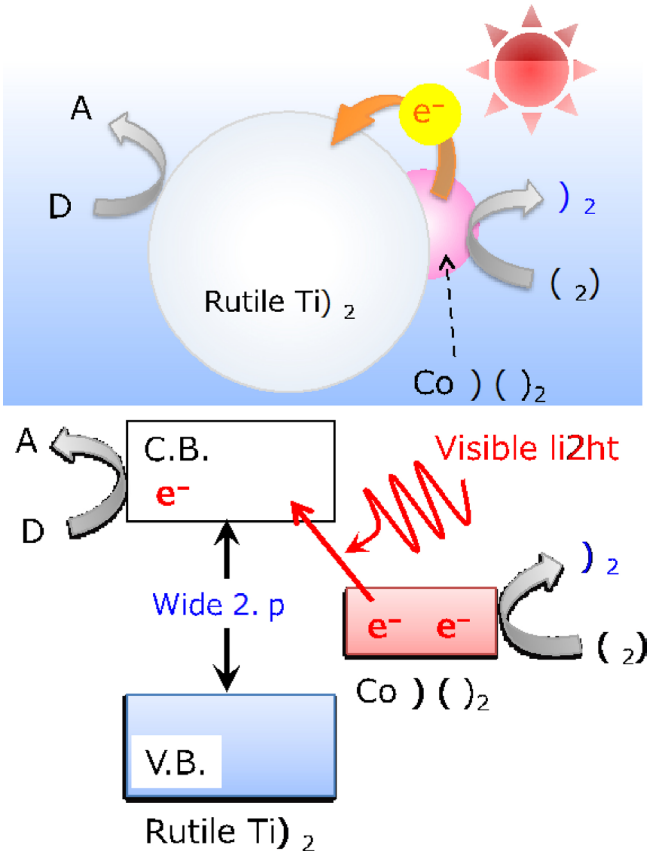

Figure 1. Visible-light-driven water oxidation using $Co(OH)_2$-modified rutile TiO_2.

References

[1] K. Maeda; K. Ishimaki; Y. Tokunaga; D. Lu; M. Eguchi, Modification of Wide-Band-Gap Oxide Semiconductors with Cobalt Hydroxide Nanoclusters for Visible-Light Water Oxidation. Angewandte Chemie International Edition. 55, 8309-8313 (2016). doi:10.1002/anie.201602764