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Molecular scale first series transition metal oxide cluster-surface modified Titanium (IV) oxide as solar environmental catalyst

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Abstract

Serious global energy and environmental issues urge us to develop environmental catalysts for decomposing pollutants in ambient water and air by utilizing solar energy named as “solar environmental catalysts”. In this lecture, I summarize recent studies on the solar environmental catalysts consisting of TiO_2 and molecular scale 3d metal oxide clusters on the surface (MOs/TiO_2). The electronic state of MOs/TiO_2 presents a fascinating scientific problem, while the photocatalytic and thermocatalytic activities are also interesting from a viewpoint of application as environmental catalysts. In the first part following the introduction, the chemisorption-calcination cycle technique for forming extremely small oxide clusters of 3d metals on TiO_2 (*Angew. Chem. Int. Ed.* **2011**, *50*, 3501), the physicochemical properties and electronic structures of MOs/TiO_2 are described. The second part deals with their thermocatalytic and photocatalytic activities for the degradation of organic pollutants, and the essential action mechanisms of the metal oxide clusters. Combination of experiments and first principles density functional simulations shows that some MOs/TiO_2 can be an ideal solar environmental catalyst working under sunlight and in the dark.

Biography

Hiroaki Tada received his BS and MS in Engineering from Kyoto University. He worked at Nippon Sheet Glass Co. as a researcher from 1981 to 1996. He received his Dr. degree in engineering from Kyoto University in 1991. He joined the staff of Environmental Research Laboratory at Kinki University in 1997, and the research group of Prof. A. T. Bell at University of California, Berkeley as an invited scholar in 2002. In 2004 he became a staff of School of Science and Engineering at Kinki University, where is currently a full professor. He has published more than 120 papers in reputed journals and serving as a high-profile editorial board member of repute Journal of Nanomaterials & Molecular Nanotechnology.