RECENT PROGRESS IN SOLAR LIGHT ENERGY UTILIZATION TECHNOLOGIES AT NIMC: WATER SPLITTING OXIDE SEMICONCDUCTOR CATALYSIS AND DYE-SENSITIZED SOLAR CELLS

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1. Introduction

With the 21st-century close at hand, we are now faced with serious global problems of energy and the environment. The developments such as artificial photosynthesis and highly selective chemical reactions might solve the global problems. And the control of photoreactions will be a key factor in these developments. Under these circumstances, NIMC have launched a five-year term COE (Center of Excellence) project, "Photoreaction Control and Photofunctional Materials", financed by the Science and Technology Agency of Japan in 1997.[1] About 50 researchers are engaged in "Photoreaction Control" research field composed of three groups, Photo-reaction mechanism, Light energy conversion and Laser-induced reaction.

Here, recent progress in solar light energy conversion technologies using oxide semiconductor materials is introduced from the fruit of COE project.

2. Solar hydrogen production

Na_2CO_3 addition method Extensive studies on water splitting by photocatalysts have been conducted all over the world since the oil crisis in 1973. However, it has proved that stoichiometrical and steady water splitting over a Pt/TiO_2 photocatalyst does not proceed easily, because of some inhibiting reactions such as charge recombination, backward reaction and peroxide formation over TiO_2 surface. We found a significant effect of Na_2CO_3 addition to water suspension of Pt/TiO_2 on water splitting[2] and investigated the role of CO_3^{2-} in detail[3]. This Na_2CO_3 addition method could produce both 420 ml/6.5h · m^2 of H_2 and 180 ml/6.5h · m^2 of O_2 from a water suspension of $3wt\%NiO_x/TiO_2$ photocatalyst under the solar light irradiation at Tsukuba, Japan.[4] Optimization of this system is now under investigations.

Two-step water splitting system for visible light utilization Unfortunately,