Time-Resolved Spectroscopic Study of Photo-Excited Charge Carrier Dynamics in Hematite Photo-Electrodes

(Chungbuk National University) SOHN, Woon Yong

In 2016, the member countries of United Nations (UN) set the Sustainable Development Goals (SDGs) and one of them was to ensure access to affordable, reliable, sustainable and modern energy for all. Because the amount of fossil fuels in our earth are limited and burning of fossil fuels inevitably causes serious environmental pollution, humanity cannot permanently use fossil fuels. Thus, as UN decided, finding alternative energy sources has been regarded as one of the most urgent issues. There are many attempts for the use of sunlight streaming toward earth for the production of hydrogen gas by splitting water as the alternative energy source. This idea has been realized since Fujishima and Honda succeeded in demonstrating the light-induced water splitting with a TiO_2 photo-anode and a Pt counter electrode for the first time.[1] Apart from TiO_2, Several kinds of semiconductor materials have been developed to be utilized for the photo-electrode in the photo-electrochemical cell. Especially, hematite (α-Fe_2O_3), one of mineral forms of iron oxide, has been regarded as one of the best materials for the purpose due to its high earth abundance, high photo-stability and low price. However, it is imperative that its low photoelectrochemical (PEC) performance, caused by multiple limiting factors such as poor conductivity, short electron-hole lifetime, and poor charge carrier transfer/transport efficiency among others, must be improved for its implementation. In order to understand the origins of the low efficiency of hematite more deeply and find ways to overcome the problems, in this study, we investigated the photo-excited charge carrier dynamics of bare and modified hematite films using time-resolved spectroscopic techniques.

[1] A. Fujishima, K. Honda, *Nature* **1972**, 238, 37-38