超高速時間分解 XAFS 測定法による半導体から助触媒への電荷移動観測

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Ultrafast time-resolved observation for carrier transfer from semiconductor to cocatalyst by means of XAFS measurement ([1]*Institute of Materials Structure Science, High Energy Accelerator Research Organization,*[2]*School of Science, Tokyo Institute of Technology*, [3]*Japan Society for the Promotion of Science*) ○Tomoki Kanazawa,[1] Fan Dongxiao,[1] Rie Haruki,[1] Ryo Fukaya,[1] Akinobu Miyoshi,[2,3] Shunta Nishioka,[2] Kazuhiko Maeda,[2] Shinichi Adachi,[1] Shunsuke Nozawa[1]

Loading of metal or metal oxide nanoparticles onto the semiconductor photocatalyst surface has been well known to be a useful strategy to enhance photocatalytic water splitting. One of these particles, which are called cocatalysts, loading effect is capturing of exited holes or electrons which are generated in the semiconductor. In this meeting, we observed the carrier transfer from semiconductor (N and F co-doped TiO_2 as visible light driven photocatalyst; TiO_2; N,F) to IrO_2 as a water oxidation cocatalyst in picoseconds scale by means of pomp-probe XAFS measurement. As the result of deference spectrum between before and after photoirradiation, IrO_2 which is loaded onto TiO_2; N,F was slightly oxidized due to pomp laser irradiation. On the other hand, valence state of Ir in single IrO_2 or IrO_2 loaded Al_2O_3 was not changed under same photoirradiation. Hence, it is suggested that hole injection from TiO_2; N,F to IrO_2 was observed by pomp-probe XAFS.

Keywords : Semiconductor photocatalyst; Cocatalyst, In situ XAFS, Time resolved measurement

半導体光触媒による水分解反応は、触媒表面に助触媒を担持することによって活性が向上する[1]。助触媒担持効果の一つに、半導体内部で生成した電子や正孔を助触媒が捕捉し、電荷分離を促進することが考えられている。本研究では放射光を用いたポンププローブ型の時間分解 XAFS 測定を実施することで、半導体である N,F 共ドープ TiO_2 (TiO_2; N,F)から助触媒である IrO_2 への、光吸収に伴う電荷移動をピコ秒の時間スケールで調べた。励起光照射前後の差スペクトルを比較したところ、TiO_2; N,F 表面の IrO_2 は、光照射に伴う電子の欠損が生じていた。他方で、IrO_2 コロイド溶液や、IrO_2 担持 Al_2O_3 では Ir の電子状態変化は見られなかった。以上の結果から、TiO_2; N,F から IrO_2 への正孔移動が可視化されたものと考えられる。

1) Photocatalytic water splitting using semiconductor particles: History and recent developments. K. Maeda, *J. Photochem. Photobiol. C* **2011**, *12*, 237.
2) Coordination and Electronic Structure of Ruthenium(II)-tris-2,2'-bipyridine in the Triplet Metal-to-Ligand Charge-Transfer Excited State Observed by Picosecond Time-Resolved Ru K-Edge XAFS. T. Sato, S. Nozawa, A. Tomita, M. Hoshino, S. Koshihara, H, Fujii, S. Adachi, *J. Phys. Chem. C* **2012**, *116*, 14232.