H_2-evolving SWCNT Photocatalysts for Effective Use of Solar Energy

Yutaka Takaguchi[1], Takumi Izawa[1], Daiki Miyamoto[1], Tomoyuki Tajima[1], Hideaki Miyake[2]

[1] *Graduate School of Environmental & Life Science, Okayama University, Okayama 700-8530, Japan*
[2] *Graduate School of Sciences & Technology for Innovation, Yamaguchi University, Yamaguchi 755-8661, Japan*

Visible and near-infrared (NIR) light-induced water splitting has received considerable attention in terms of solar energy conversion and hydrogen energy storage. Single-walled carbon nanotubes (SWCNTs) are potentially strong optical absorbers with tunable absorption wavelengths depending on their chiral indices (*n,m*). In order to make SWCNTs act as a H_2-evolving photocatalyst, we have developed coaxial p-n heterojunction systems consisting of a SWCNT and fullerodendrons, such as SWCNT/fullerodendron [1], SWCNT/fullerodendron/SiO_2 [1], SWCNT/fullerodendron/ Pt(II) [2,3,5], and SWCNT/fullerodendron/TiO_x [4]. Moreover, we have found SWCNT/dendrimer that does not contain C_{60} acts as a photosensitizer for H_2 evolution in the presence of methyl viologen dication (MV^{2+}) [6]. By the use of these SWCNT-photocatalysts, we can effectively use solar energy since the mixture of SWCNTs with different helicities exhibits satisfiable efficiency of H_2 evolution from water. Recently, we fabricated SWCNT-photocatalyst based on dye-encapsulated SWCNTs in order to challenge the enhancement of light-absorbing ability [7].

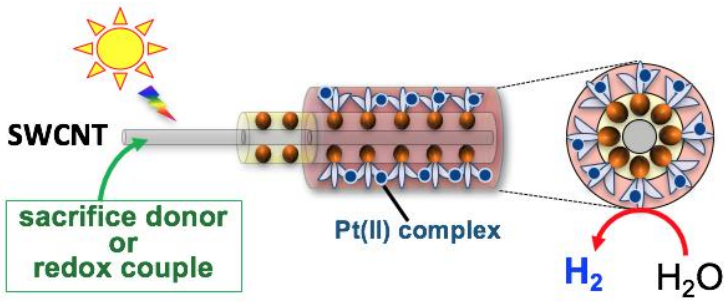

Fig.1 A schematic illustration of H_2 evolution reaction using a SWCNT-photocatalyst, SWCNT/fullerodendron/Pt(II).

[1] T. Tajima, W. Sakata, Y. Takaguchi *et al*. Adv. Mater. **23**, 5750 (2011).
[2] Y. Sasada, T. Tajima, Y. Takaguchi *et al*. New J. Chem. **37**, 4214 (2013).
[3] N. Murakami, H. Miyake, T. Tajima, Y. Takaguchi *et al*. Sci. Rep. **7**, 43445 (2017).
[4] K. Kurniawan, T. Tajima, H. Miyake, Y. Takaguchi *et al*. RSC Adv. **7**, 31767 (2017).
[5] K. Kurniawan, T. Tajima, Y. Takaguchi *et al*. Proc. Nature Res. Soc. **1**, 01004 (2017).
[6] K. Ishimoto, T. Tajima, H. Miyake, Y. Takaguchi *et al*. Chem. Commun. **54**, 393 (2018).
[7] Y. Takaguchi *et al*. J. Am. Chem. Soc. in press (2018). DOI: 10.1021/jacs.7b12845