課題番号　：F-13-HK-0042
利用形態　：機器利用
利用課題名（日本語）　：
Program Title (English)　：Plasmon-induced water splitting under visible light irradiation
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1. 概要（Summary）

Photocatalytic production of hydrogen (H_2) and oxygen (O_2) via water splitting over semiconductor photocatalyst is a promising technic. Noble metal nanoparticles deposited on a semiconductor have the potential to promote catalytic property, due to the light harvesting effect based on localized surface plasmon resonances [1]. Herein, we proceeded with the plasmon-assisted water splitting with a visible light irradiation.

2. 実験（Experimental）

Gold nanoislands were prepared by helicon sputtering (MPS-4000, ULVAC) of gold film with a thickness of 3 nm on the surface of 0.05wt% niobium-doped strontium titanate (Nb-$SrTiO_3$) and annealing at 800ºC for 1h in a nitrogen atmosphere. The average diameter of the gold nanoislands was estimated to be around 52 nm by SEM (JSM-6700FT, JEOL). About 0.2 mm thick Pt board was stick on the back side of the $SrTiO_3$ substrate. The substrate was then assembled into a sealed reaction cell. To adjust a chemical bias between front (O_2 evolution) and back side (H_2 evolution) chambers, pH regulation was employed. The amount of evolved reaction products was determined by GC-MS (2010-plus, Shimadzu) and GC-TCD (2014, Shimadzu). According to the extinction peak wavelength, the xenon light filtered to the wavelength from 550 nm to 650 nm with an intensity of 0.32 W/cm^2 was irradiated onto the gold nanoislands to excite localized surface plasmon resonance.

3. 結果と考察（Results and Discussion）

Under the irradiated conditions, the evolution of both H_2 and O_2 is linearly increased with an irradiation time. The quantity of H_2 evolved is twice that of O_2 evolved from gold nanostructured surface. Therefore, stoichiometric evolution of H_2 and O_2 was obviously demonstrated with the water splitting device. The action spectrum of the H_2 evolution was almost accordance with plasmon resonance spectrum. Thus, plasmon-induced water splitting was clearly demonstrated.

4. その他・特記事項（Others）

[1] Y. Nishijima, K. Ueno, Y. Yokota, K. Murakoshi, H. Misawa, J. Phys. Chem. Lett. 1, 2031 (2010).

5. 論文・学会発表（Publication/Presentation）

(1) Y. Zhong et al., 2013 年光化学討論会, 愛媛大学, 松山, 9 月 (2013).
(2) Y. Zhong et al., 第 23 回日本 MRS 年次大会, 横浜市開港記念会館, 12 月 (2013).
(3) Y. Zhong et al., THE 14th RIES-HOKUDAI International Symposium 網 [mou], Gateaux Kingdom Sapporo, Sapporo, Dec (2013).
(4) Y. Zhong, 1st International Symposium on Ambitious Leader's Program for Fostering Future Leaders to Open New Frontiers in Materials Science, Hokkaido University, Sapporo, March (2014).
(5) Y. Zhong et al., 日本化学会第 94 春季大会, 名古屋大学, 3 月 (2014).

6. 関連特許（Patent）

なし。