課題番号　:F-14-HK-0060
利用形態　:機器利用
利用課題名（日本語）　:
Program Title (English)　:Improvement of Plasmon-Enhanced Water Splitting using Gold Nanostructured $SrTiO_3$ Single Crystal Photoelectrode with TiO_2 Thin Film Heterojunction
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1. 概要（Summary）

We developed a plasmon-enhanced water splitting system using a gold nanostructured $SrTiO_3$ single crystal photoelectrode with a TiO_2 thin film heterojunction. Simultaneous evolution of hydrogen and oxygen was observed in separate reaction chambers under visible light irradiation. The substrate composed of single crystal $SrTiO_3$ with a rutile TiO_2 thin film heterojunction exhibited enhanced water spitting activity compared with the electrode without the TiO_2 thin film because the synergistic effect may prevent the back electron transfer reaction.

2. 実験（Experimental）

・Apparatus

Atomic layer deposition, Scanning electron microscopy, Gas chromatography-mass spectrometer, Gas chromatograph with thermal Conductivity detector, X-ray diffraction, Magnetron sputtering deposition

・Method

A thin gold film was deposited on the front side of the $SrTiO_3$ by helicon sputtering. The thin film was transformed to discontinuous gold nanoparticles (Au-NPs) after annealing at 800°C for 1 h in a nitrogen atmosphere. As a H_2 evolution co-catalyst, a Pt thin film was subsequently sputtered on the back side of the $SrTiO_3$ substrate. A TiO_2 thin film was deposited on the back side of a $SrTiO_3$ substrate by atomic layer deposition prior to the Pt decoration as a comparison.

3. 結果と考察（Results and Discussion）

The water splitting activity was increased with rutile layer decoration. Because the conduction band of rutile is 0.2 eV lower than $SrTiO_3$. There is a potential gradient between the two sides of the substrate, under its influence the electrons are transferred from the Au-NPs to the Pt co-catalyst. With the lower conduction band at the H_2 evolution side, the electron transfer is facilitated due to the greater band slope that prevents back electron transfer. For anatase-type TiO_2, whose conduction band energy is almost same as $SrTiO_3$, the activity decreased. Because of the recombination between electrons and holes are aggravated.

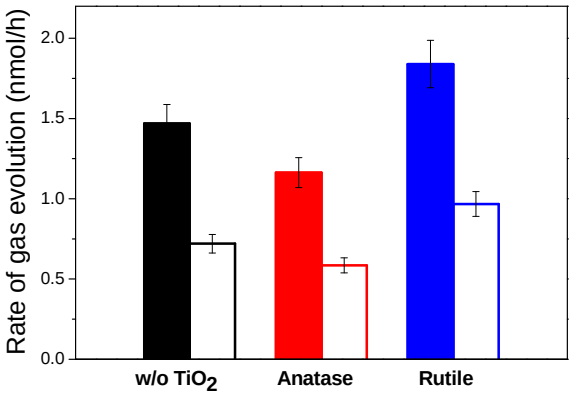

Fig. 1　H_2 and O_2 evolution rates with anatase or rutile layers compared with that without a TiO_2 layer.

4. その他・特記事項（Others）

・Reference

D. Tsukamoto et al., *J. Am. Chem. Soc.* **134**, 6309 (2012).

5. 論文・学会発表（Publication/Presentation）

なし

6. 関連特許（Patent）

出願済み