

課題番号 : F-18-HK-0034  
 利用形態 : 機器利用  
 利用課題名(日本語) :  
 Program Title (English) : Plasmon-induced Photocurrent Generation on Ga<sub>2</sub>O<sub>3</sub> Loaded with Gold Nanoparticles  
 利用者名(日本語) : 王亞光  
 Username (English) : Yaguang Wang  
 所属名(日本語) : 北海道大学大学院情報科学研究科  
 Affiliation (English) : Graduate School of Information Science and Technology, Hokkaido University  
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## 1. 概要(Summary)

Ga<sub>2</sub>O<sub>3</sub> is a promising semiconductor with a much negative conduction band compared with TiO<sub>2</sub>. The large band gap makes it inactive in the visible light. Au nanoparticles (Au-NPs) were loaded on the surface of to improve the use of visible light due the strong interaction between visible light and Au-NPs [1]. In addition, the interface structure is also a critical factor we need to consider. Some references have reported that TiO<sub>2</sub> layer has high ability to capture holes. Hence, an interface modification was applied using a thin TiO<sub>2</sub> layer to increase the hole trapping at the interface so that the recombination can be reduced.

## 2. 実験(Experimental)

### 【利用した主な装置】

Atomic layer deposition (ALD) (Picosun SUN-R), SEM (JEOL JSM-6700FT)

### 【実験方法】

A 3-nm Au thin-film was evaporated on the Sn doped single crystal Ga<sub>2</sub>O<sub>3</sub> by E-beam evaporation. Au-NPs were fabricated on by thermal annealing at 800°C. Titanium dioxide thin films were deposited onto Au-NPs loaded Ga<sub>2</sub>O<sub>3</sub> using ALD. The surface morphology was observed by scanning electron microscopy (SEM).

## 3. 結果と考察(Results and Discussion)

In this study, to further improve the oxidation process of water splitting, a thin TiO<sub>2</sub> layer with several nanometers was deposited on the Au-NPs/Ga<sub>2</sub>O<sub>3</sub> by ALD. The IPCE and absorption

calculated by  $\Delta(1-T-R)$  of the Au-NPs/Ga<sub>2</sub>O<sub>3</sub> system showed an increment compared with samples without the interface modification, indicating that the interface modification by TiO<sub>2</sub> layer has a positive effect. Although the mechanism of the photocurrent enhancement by TiO<sub>2</sub> modification on Au-NPs/Ga<sub>2</sub>O<sub>3</sub> is still unclear, it is speculated that the absorption enhancement due to the refractive index increment of surrounding medium of Au-NP, and flat-band potential change could affect the hot-electron induced photocurrent generation.

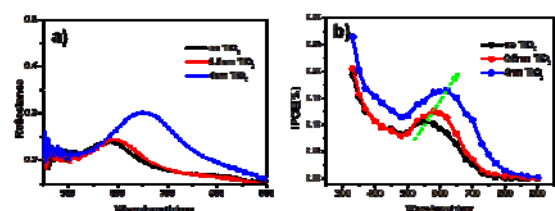


Figure 1. (a) Absorption spectrum of samples after TiO<sub>2</sub> modification with different thickness. (b) IPCE spectra of samples after TiO<sub>2</sub> modification with different thickness.

## 4. その他・特記事項(Others)

### ・参考文献

[1] K. Maeda, K. Domen, *J. Phys. Chem. C*, 111 (2007) 7851-7861.

## 5. 論文・学会発表(Publication/Presentation)

(1) Y. Wang, X. Shi, T. Oshikiri, K. Ueno, H. Misawa, The 66th JSAP Spring Meeting, 平成 31 年 3 月 9 日(Presentation)

## 6. 関連特許(Patent)

なし