課題番号　:F-20-HK-0018
利用形態　:機器利用
利用課題名（日本語）　:
Program Title (English)　:Photocurrent Generation on Gold Nanoparticles Loaded Ga_2O_3 .
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1. 概要（Summary）

Ga_2O_3 is a promising semiconductor with a much negative conduction band. 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 [1,2]. In our previous work, strong coupling between optical cavity and plasmon mode could efficiently enhance the light absorption and carrier separation. To construct the optical cavity, the thickness of Ga_2O_3 is just tens of nanometer scale. Therefore, Ga_2O_3 film with good conductivity and mobility is necessary in our following research. Pulse Laser Deposition is a kind of ideal method to fabricate the semiconductor film. In this work, deposition condition was investigated to obtain Ga_2O_3 with good quality.

2. 実験（Experimental）

【利用した主な装置】

半導体薄膜堆積装置 (PLD) (PAC-LMBE), 電子ビーム蒸着装置 (EIKO Engineering Co.,Ltd. EB-580), 高分解能電解放射型走査型電子顕微鏡 (JEOL JSM-6700FT)

【実験方法】

The Sn doped Ga_2O_3 target was sintered at 1400°C for 10h. Ga_2O_3 film was fabricated by PLD under different deposition condition. Then 3-nm Au film was deposited on Ga_2O_3 film by E-beam Evaporation. Au-NPs were fabricated by thermal annealing at 800°C in air. The surface morphology was observed by scanning electron microscopy (SEM).

3. 結果と考察（Results and Discussion）

In this study, the laser energy, oxygen pressure deposition temperature and annealing temperature are the main factors we studied. XRD spectra showed the Ga_2O_3 film was obtained with very good crystallinity. Optical band gap calculated by the UV-Vis spectrum is 4.9 eV which is consist with reference value. The IPCE and I-V spectra showed that oxygen pressure and the annealing temperature mainly determine the electric properties of Ga_2O_3 film. As formation of oxygen vacancy is the main conductivity mechanism for Ga_2O_3 film. The deposition of Ga_2O_3 should be in poor oxygen condition. Too high annealing temperature would damage the oxygen vacancy, destroying the photoelectric response. After the modification of fabrication condition, Ga_2O_3 film with good semiconductor properties was obtained.

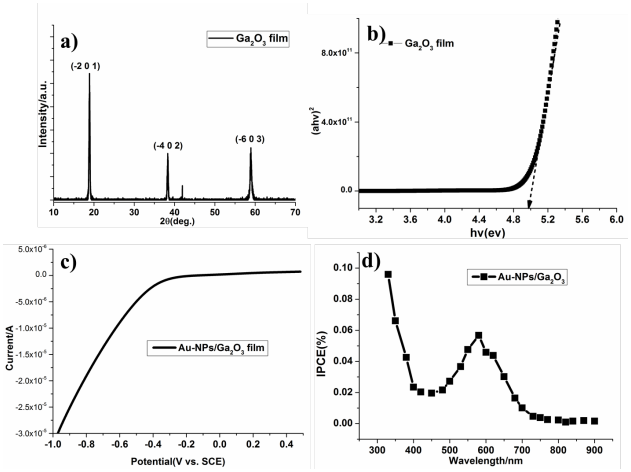

Figure 1. (a) XRD spectrum of Ga_2O_3 film. (b) Tauc plot of Ga_2O_3. (c) I-V curve of Au-NPs loaded Ga_2O_3 film. (d) IPCE of Ga_2O_3 film.

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.

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5. 論文・学会発表（Publication/Presentation）

[2] Y. Wang et al, *Nanoscale* 2020, 12, 22674-22679.

6. 関連特許（Patent）

なし