課題番号　　:F-15-HK-0066
利用形態　　:共同研究
利用課題名（日本語）　　:
Program Title(English)　　:Tuning Plasmon-Enhanced Photocurrent Generation by the Interference in TiO_2 Thin-film
利用者名（日本語）　　:
Username(English)　　:Hoang Chung
所属名（日本語）　　:イムラ・ジャパン株式会社
Affiliation(English)　　:IMRA JAPAN Co., Ltd.

1. 概要（Summary）

Thin-film solar harvesting system is prospecting for next generation solar cell. The TiO_2 thin film was fabricated by atomic layer deposition, a well-controlled thin film thickness and perfect step coverage deposition method, on a 50-nm aluminum thin film coated silica glass. The gold nano-islands (Au-NIs) structure, which exhibits characteristic plasmon resonance, were subsequently decorated on the surface of TiO_2 thin film by sputtering a 3-nm gold thin film and annealing at 250°C. Due to the large difference of refractive index, TiO_2 thin film exhibited a strong interference.[1] When the transmission constructive interference overlap with the plasmon resonance of Au-NIs, the plasmon-enhanced photocurrent generation on Au-NIs/TiO_2 system could be enormously increased.

2. 実験（Experimental）

【利用した主な装置】

ALD (Picosun SUN ALE-R), Helicon Sputtering (ULVAC MPS-4000C1/HC1, SEM (JEOL JSM-6700FT), STEM/TEM (JEOL ARM 200F)

【実験方法】

A 50-nm Al thin film was thermal evaporated on the surface of silica glass. TiO_2 thin films were deposited onto the Al coated silica glass by ALD (SUNALETM R series, Picosun, Finland). Sequentially, a 3-nm gold thin film was evaporated and then annealed in H_2 (3.9% in Ar) at 250°C for 2 hours. The surface morphology of the Au-NIs/TiO_2 were observed by field-emission scanning electron microscopy (FE-SEM, JSM-6700FT, JEOL). The cross-section analysis was carried out with a JEOL ARM200F aberration corrected TEM/STEM equipment.

3. 結果と考察（Results and Discussion）

A highly corresponding of the IPCE action spectra bands to the (1-R) spectra of TiO_2 thin films is shown in Figure 1, which indicates a tunable plasmon-enhanced photocurrent generation can be implemented by controlling the interference in TiO_2 thin film. The IPCE dependence on the overlap of (1-R) of TiO_2 thin film and the extinction of Au-NIs further illustrates that the photocurrent generated on Au-NIs/TiO_2 originated from the plasmon resonance of Au-NIs.

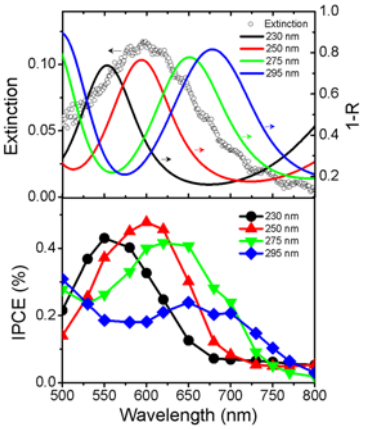

Fig. 1 Extinction spectrum of Au-NIs, and (1-R) Spectra and IPCE of Au-NIs/TiO_2/Al

4. その他・特記事項（Others）

共同研究者

（イムラジャパン株式会社）林 弘毅，伊藤泰雄

（北大電子研）石 旭，上野貢生，三澤弘明

・参考文献

(1) X. Shi eta al., J. Phys. Chem. C 117, 2494-2499 (2013)..

5. 論文・学会発表（Publication/Presentation）

なし

6. 関連特許（Patent）

なし