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利用形態 :機器利用
利用課題名（日本語） :
Program Title (English) :Near-Field Engineering for Boosting the Photoelectrochemical Activity to a Modal Strong Coupling Structure
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1. 概要（Summary）

We used a facile constant potential electrolysis technique to tailor the near-field distribution on Au nanoparticles (Au-NPs)/TiO_2 thin-film/Au-film (ATA) structure for higher photoelectrochemical activity.[1-3)]

2. 実験（Experimental）

【利用した主な装置】

原子層堆積装置(Picosun SUNALE-R), ヘリコンスパッタリング装置 (ULVAC, MPS-4000C1/HC1), 超高分解能電界放出形走査電子顕微鏡 (SU8230)

【実験方法】

A 100 nm Au film and a 2-nm titanium film were sputtered in sequence on the surface of the silica glass using a Helicon sputtering system. Afterward, a 28 nm titanium dioxide (TiO_2) thin film was deposited onto the Au film using a commercial hot-wall flow-type atomic layer deposition (ALD) reactor with titanium tetrachloride ($TiCl_4$) and H_2O as precursors; the deposition temperature was held at 300 ºC. A 3-nm Au thin film was sequentially evaporated in a thermal evaporator at a deposition rate of 0.1 Å•s^{-1}. Finally, the samples were annealed in air at 300 °C for 2 h, and the Au-NPs appeared on the TiO_2 film surface. To fabricate the partially inlaid Au NPs, a 7-nm TiO_2 thin film was additionally deposited on by ALD. Then, the samples were annealed in air at 300 °C for 2 h.

Au was electrochemically postdeposited on ATA using a three-electrode system, with the ATA structure as the working electrode (WE), a platinum wire as the counter electrode (CE) and a saturated calomel electrode (SCE) as the reference electrode (RE). The 0.25 mmol•dm^{-3} $HAuCl_4$ with 0.1 mol•dm^{-3} Na_2SO_4 was used as the Au precursor, in which Na_2SO_4 worked as a stabilizer and electrolyte.

3. 結果と考察（Results and Discussion）

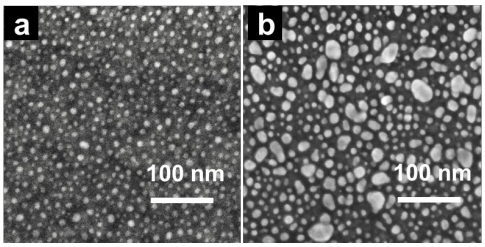

Fig. 1 SEM images of (a) ATA and (b) Au@ATA structures.

Fig. 1 shows typical top-view SEM images of ATA and Au@ATA structures. As shown in Fig. 1a, Au-NPs are deposited on the surface of TiO_2 with high dispersity and the average particle size of Au-NPs on ATA is estimated as 10 ± 6.7 nm. After electrodepositing Au on the ATA structure, as shown in Fig. 1b, the size of Au-NPs grew larger and the average particle size of Au-NPs on ATA is estimated as 12 ± 9.1 nm. These Au@ATA structures are demonstrated to show much higher incident photo-to-current conversion efficiency (IPCE) under visible light irradiation.

4. その他・特記事項（Others）

・参考文献

1) X. Shi et al., *Nat. Nanotechnol.*, 2018, 13, 953-958.
2) Y. Cao et al., *ChemNanoMat*, 2019, 5, 1008-1014.

5. 論文・学会発表（Publication/Presentation）

3)Y. Cao et al., *Chem. Commun*. 2021, 57, 524-527

6. 関連特許（Patent）

なし