課題番号　　:F-19-HK-0055
利用形態　　:共同研究
利用課題名（日本語）　:
Program Title (English)　:　Enhanced plasmonic photocatalysis with molecular co-catalysts
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キーワード／Keyword　:Nanocavity, Plasmon, Photo-Catalysis, 成膜・膜堆積

1. 概要（Summary）

We demonstrate how the photo-electrochemical efficiency of Au nanoparticle/TiO_2/Au-film (ATA) photoelectrodes can be improved by anchoring a monolayer of a Ruthenium (II) complex on the surface of the nanoparticles.

2. 実験（Experimental）

【利用した主な装置】

原子層堆積装置（SUNALE-R），ヘリコンスパッタリング装置（MPS-4000C1/HC1），高分解能電界放射型走査型電子顕微鏡（JSM-6700FT），収差補正走査型透過電子顕微鏡（ARM-200F）

【実験方法】

A 100-nm Au film was deposited on the surface of silica glass by sputtering. TiO_2 thin films were subsequently deposited *via* ALD. Au-NPs were finally produced by thermal annealing of a 3-nm Au thin-film at 300°C. Finally, a monolayer of N3 dye [cis-bis(isothiocyanato)bis(2,2′-bipyridyl-4,4′-dicarboxylato) ruthenium(II)] was self-assembled on the Au-NPs. The surface morphology was observed by SEM while the presence of the N3 monolayer was ascertained by Raman spectroscopy.

3. 結果と考察（Results and Discussion）

Figure 1 (top) shows the optical absorption spectrum of the resulting structures, which exhibits a doublet that is characteristic of the strong interaction between localized surface plasmon resonances in the metal nanoparticles and the Fabry-Pérot resonance that takes place in the metal-spacer-metal structure[1]. Figure 1 (bottom) shows measured current *vs* voltage curves obtained in an aqueous electrolyte solution of KOH (0.1 mol/dm^3) for the case where the ATA structure was functionalized with a monolayer of the N3 co-catalyst (blue line) and without (grey line). These results provide compelling evidence that the efficiency of water oxidation by ATA structures can be significantly enhanced with this approach.

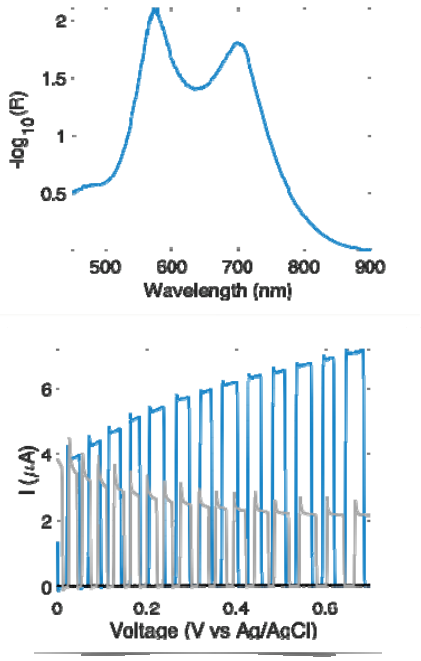

Figure 1: (Top) Optical absorption spectrum of the samples. (Bottom) Current-voltage curves for (grey) a control sample and (blue)　a sample with a monolayer of N3

4. その他・特記事項（Others）

・*参考文献*

[1] X. Shi, K. Ueno, T. Oshikiri, Q. Sun, K. Sasaki, H. Misawa, *Nat. Nanotechnol.*, 13, 953-958 (2018).

Main collaborators: Xu Shi, Tomoya Oshikiri, Yangfeng Cao, Hiroaki Misawa (RIES-Hokkaido University)

5. 論文・学会発表（Publication/Presentation）

なし

6. 関連特許（Patent）

なし