課題番号　　:F-15-HK-0063
利用形態　　:共同研究
利用課題名（日本語）　　:プラズモン―励起子ハイブリッド状態のダイナミクス
Program Title (English)　　:Dynamics of exciton-plasmon strong coupling system of J-aggregate and gold nanostructure
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1. 概要（Summary）

Recently, strong coupling between localized surface plasmon (LSP) and excitons have been studied in hybrid systems of metallic nanostructures and dye J-aggregates. In this study, strong coupling was induced in hybrid systems of gold nanostructures and porphyrin J-aggregate and its ultrafast dynamics were studied by using a femtosecond transient absorption measurement system.

2. 実験（Experimental）

·Apparatus

Helicon sputtering system (MPS-4000C1 /HC1, ULVAC), High-resolution electron beam lithography system (ELS-F125-U, Elionix), Atomic layer deposition (SUNALE-R, Picosun), ICP plasma etching (RIE-101iPH, SAMCO), FE-SEM (JSM-6700FT, JEOL)

·Method

Planar patterns of square-shaped gold nanoblocks with thickness of 50 nm were fabricated by electron beam lithography on the porphyrin J-aggregate film and an alumina layer with thickness of 1.5 nm by atmic layer deposition formed on a glass substrate. Then plasma etching was performed with the mask of nanoblocks to remove uncoupled molecules. Transient absorption spectroscopy were performed to elucidate the dynamics of relaxation process of the strong coupling states.

3. 結果と考察（Results and Discussion）

The SEM image of hybrid system is shown in Fig. 1. Porphyrin J-aggregates were formed under the gold nanoblocks successfully. In this hybrid system, we have demonstrated the spectral property of a plasmon-exciton strong coupling states with Rabi-splitting energy of 200 meV. Extinction spectrum of a hybrid system and the transient absorption spectra excited lower branch polariton with wavelength of 735 nm were shown in Fig. 2. We have observed the formation of hybrid-states and its relaxation with fast and slow time decay within several tens of femtosecond and several picoseconds under resonant excitation.

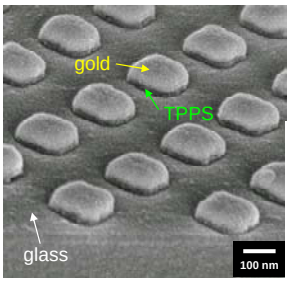

Fig. 1 SEM image of hybrid system of porphyrin J-aggregates and gold nanostructures..

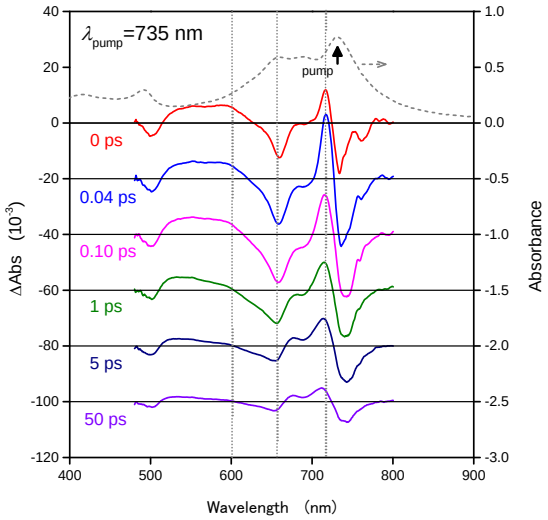

Fig. 2 Extinction and transient absorption spectra of a hybrid system under 735 nm wavelength excitation.

4. その他・特記事項（Others）

・共同研究者等（Coauthor）: (RIES, Hokkaido Univ.)H. Uehara, J. Li, T. Oshikiri, K. Ueno, H. Misawa

5. 論文・学会発表（Publication/Presentation）

(1) H. Uehara, Q. -D. Chen et al., Pacifichem 2015 meeting, Honolulu, USA, Dec. 2015.

6. 関連特許（Patent）

なし