課題番号　　:F-15-HK-0060
利用形態　　:機器利用
利用課題名（日本語）　　:
Program Title (English)　　:Fabrication of a nanostructured photoelectrode with titania inversed opal photonic crystals
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1. 概要（Summary）

Opal photonic crystals are promising materials for applications in optoelectronics and photonic devices due to their optical functionalities and the tunability of photonic stop band in a wide wavelength region. In the present study, we have fabricated a nanostructured photoelectrode with titania inversed opal photonic crystals whose photonic stop band existing in visible wavelength region by utilizing atomic layer deposition.

2. 実験（Experimental）

·Apparatus

Atomic layer deposition (SUNALE-R, Picosun), FE-SEM (JSM-6700FT, JEOL)

·Method

Polystyrene (PS) opal photonic crystals were formed on a glass substrate. PS spheres (diameter: 283 nm, Sekisui) dispersed in an aqueous solution were dropped on the substrate and dried at 50ºC. The opal structure is used as a template for fabricating inversed photonic crystals. Then, titanium dioxide (TiO_2) were deposited on the PS opal photonic crystals by using atomic layer deposition (ALD) technique at 80ºC with various thicknesses of 20-40 nm. PS beads were removed by heating at 500ºC.

3. 結果と考察（Results and Discussion）

The typical SEM images of TiO_2 inversed opal nanostructures are shown in Fig. 1. We have successfully fabricated inversed opal structures with face-centered cubic structure. The thickness of the inversed structure is estimated to be several micrometer (around 10 periodic layers). Reflection spectra of the TiO_2 inversed opal structures with a different thickness were shown in Fig. 2. We have confirmed wavelength tunability of photonic stop band by controlling the thickness. The nanostructure can be applied to the TiO_2 photoelectrode having optical functionality. In the future, gold nanoparticles will be loaded on the TiO_2 surface to make a plasmon-enhanced water splitting system, expecting the synergy effect of photonic stop band and plasmonic light confinement.

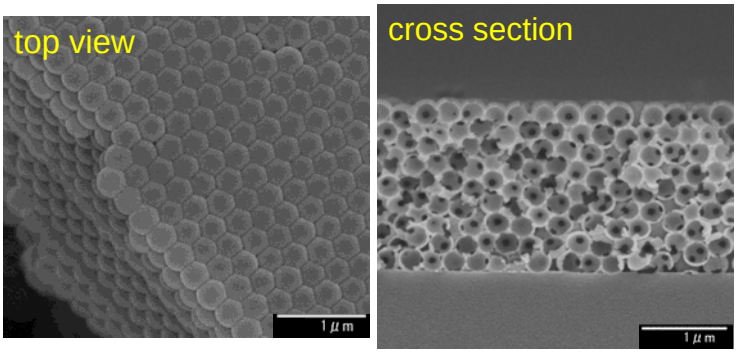

Fig. 1 SEM images of inverse TiO_2 opal photonic crystals.

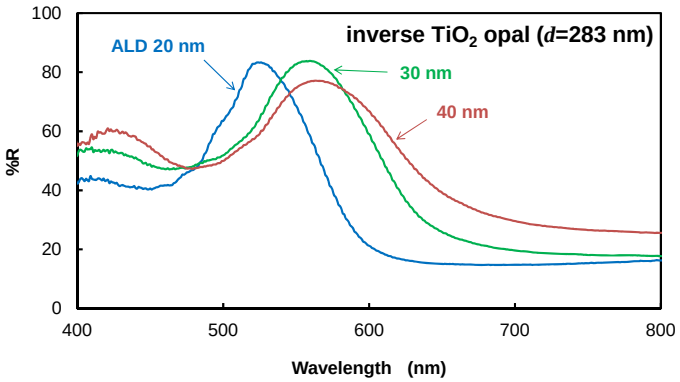

Fig. 2 Reflectance spectra of inverse TiO_2 opal photonic crystals at various deposition thickness of TiO_2.

4. その他・特記事項（Others）

なし

5. 論文・学会発表（Publication/Presentation）

なし

6. 関連特許（Patent）

なし