The Role of Order in the Amplification of Light Energy Conversion in Dye-sensitized Solar Cell Coupled to a Photonic Crystal

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Abstract

"We investigate the cause of amplification in light energy conversion when coupling a nc-TiO_2 film to a TiO_2 inverse opal by comparing to an inverse TiO_2 glass (i-TiO_2-g), fabricated with the exact monodisperse air-hole size as an inverse opal with a stop band at 600 nm (600-i-TiO_2-o). A significant ~two-fold average gain in the photon-to-current conversion efficiency was measured within the dielectric band at 600-i-TiO_2-o/nc-TiO_2 bilayer in front-wall and back-wall illumination, greater than the gain within the stop band. A smaller amplification was measured in front-wall and no gain was measured in back-wall illumination at i-TiO_2-g/nc-TiO_2. It is postulated that a photonic crystal modifies the flow of light through a film coupled with it not only within the gap but also within its dielectric band. This light trapping effect is dependent on structural order as a disordered film did not yield the same gain. A drop in the transmission of light was measured within the dielectric band upon adding nc-TiO2 to 600-i-TiO_2-o, consistent with slower propagation of light in the bilayer." (copyright ChemPhysChem, publication of Wiley. DOI 10.1002/cphc.201500942R1. *ChemPhysChem.* Volume 17, Issue 2, January 18, 2016. Pages 260–269 (**2016**))