SEMICONDUCTOR QUANTUM DOTS DOWNCONVERTERS FOR SILICON SOLAR CELLS

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The combination of solar cells (SC) with luminescent "down converters" based on colloidal quantum dots (CQD) have been suggested as a very promising method to high power conversion efficiencies. For "down-conversion", the luminescent converter (LC) as like thin film contains CQD is located on the front surface of the SC. High-energy photons with energy more than *Eg* are absorbed by the converter and down-converted into lower energy photons which, in turn, can be absorbed by the solar cell. In this work, we investigate the use of CQD (PbS, PbS-CdS, CdSe-CdS-ZnS, CdTe) into photovoltaic technology to increase of efficiency of silicon SC.

Conventional silicon SC only effectively converts photons of energy close to the Si band gap as a result of the mismatch between the incident solar spectrum and the spectral absorption properties of the material. This loss can be reduced by using photoluminescence, where by photons are shifted into an energy range where the cell has a higher spectral response. CQD were proposed for use as down-shifters because the emission wavelength can be tuned by their size, as a result of quantum confinement. In order to analyze the effect of the LC we performed a series of optical and PV measurements. The LC or thin layers were characterized using PL measurements to verify the CQD formation and quantify their light emission. There is a high PL emission with a peak at 627 nm(CdSe/ZnS), 761 nm (CdTe), 875 nm(PbS/CdSe), respectively. Figure 1 showed spectra of diffuse reflectance of SC(1), luminescence spectrum of CdSe/ZnS(2), CdTe(3), PbS/CdS(4).

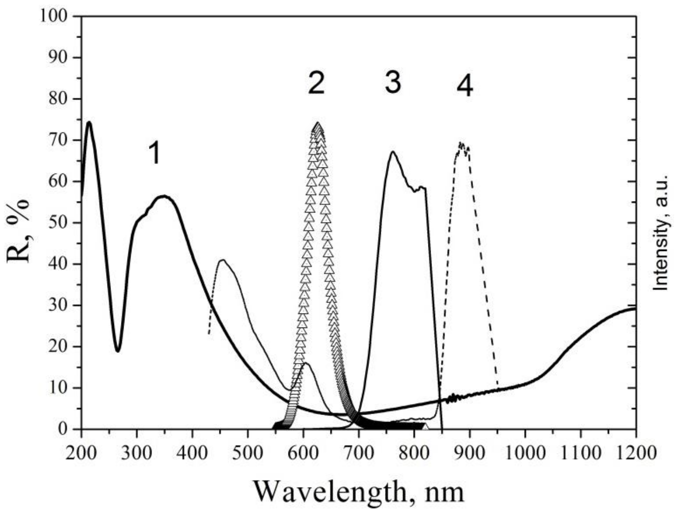

Fig.1. Spectra of diffuse reflectance of SC(1), luminescence spectra of QCD CdSe/ZnS(2), CdTe(3), PbS/CdS(4).

PV measurements were performed at standart condition, 25 ^{0}C, AM1.5 irradiation to extract the power conversion and quantum efficiency of the solar cells. These measurements showed an increase of efficiency of coated SC.

We showed that CQD are efficient down-shifters for photovoltaic applications. An enhancement of the quantum efficiency of about 4-8% was demonstrated in 200-1100 nm optical range. Further work is required to optimize the QCD down-shifter in order to increase the overall power conversion efficiency of the solar cell. Using QCD with high QY can potentially increase the efficiency of SC to 20%. Also the QCD down-shifter will play also the role of an antireflection coating, and the reflection losses will be reduced. Therefore, the combination of antireflection coating and down conversion leads to increasing the efficiency SC.