Nanocomposites and nanomaterials

Photosensitivity of the CdS:Au NPs/CdTe heterostructures

V.V. Kusnezh[1], H.A. Il'chuk[1], R.Yu. Petrus'[1], E. Płaczek-Popko[2], K. Gwóźdź[2], E.O. Zmiiovska[1], I.V. Semkiv[1]

[1] Lviv Polytechnic National University, Physics Department, Lviv, S. Bandery 12, 79013, Ukraine
E-mail: v.kusnezh@gmail.com

[2] Department of Quantum Technologies, Faculty of Fundamental Problems of Technology, Wroclaw University of Science and Technology, Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland

In order to improve the light trapping in CdS/CdTe thin-film solar cells (SC) the metallic nanoparticles embedded can increase the photoabsorption as a result of the enhanced electric field and forward-scattering upon excitation of the surface plasmon resonance (SPR). For the Si SC the location of NPs on top, inside the window layer or onto the back contacts is a subject of intensive studies [1].

Cadmium sulfide (CdS) and telluride (CdTe) thin films were deposited by the magnetron rf-sputtering method. The CdS and CdTe target of 99.999% purity and 40 mm in diameter was employed. The substrates were heated to 300°C by the 300 W tungsten high temperature substrate heater. The Au NPs arrays were obtained by direct growth from aqueous solution of $AuCl_3$, formaldehyde and Na_2CO_3. Post deposition 400°C, 1 h annealing was performed to evaporate water residuals and improve NPs adhesion to CdS film substrate.

The photosensitivity of the CdS:Au NPs/CdTe/Ni solar cells grown by superstrate configuration has been investigated. Created structures exhibit rectifying properties with positive polarity of CdTe film at a forward bias. Room temperature spectral response (SR) and external quantum efficiency (EQE) dependences of the CdS/CdTe SC with AuNPs array embedded in CdS window layer were investigated. Obtained results were compared with the results for the reference CdS/CdTe cell without AuNPs.

1. *Winans J.D., Hungerford C., Shome K., Rothberg L.J., Fauchet P.M.* Plasmonic effects in ultrathin amorphous silicon solar cells: performance improvements with Ag nanoparticles on the front, the back, and both // Optics Express.-2015.-**23**, N 3.-P. A92-A105.