Nanostructured surfaces

The gold nanoparticles on the CdS semiconductor films morphology and optical properties

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The CdS/CdTe thin-film solar cell (SC) maximal efficiency 19.6% [1] is still far from the theoretical one 28-30%. Further increase of SC efficiency requires a new approach, in particular, usage of more effective mechanisms of light absorption. Thin-film SC performance can be greatly improved by deposition of metal nanoparticles on the top of photoactive layer. SC efficiency improvement is caused by increase of light absorption in thin-film layer due to light scattering and absorption on metal nanoparticles (NP) [2], and electromagnetic field amplification by means of surface plasmon (SP) excitation in active layer. The above mentioned method allows to ensure the considerable increase of total power absorbed by SC photoactive layer with NP inclusions. Such works are being carried out on the basis of silicon SC with silver NP.

Application of gold NP in CdS/CdTe SC is possible when SP fundamental absorption is localized within the SC spectral range (500–820 nm). Such conditions are satisfied by gold NP of various dimension and geometry.

The possibility of formation of gold NP array on the CdS semiconductor films by the method of thermal annealing in vacuum of the 6 nm gold thin solid films deposited by the magnetron sputtering was investigated. It has been experimentally established that annealing at temperatures under melting point gives rise to construction of the solid film into the island film. According to APM data this film consists of NP arrays in the form of oblate spheroids with a mean diameter of 61±3 nm and a mean height of 55 nm. The positions of plasmon resonance peaks at a wavelength of 593 nm were determined by the method of optical spectroscopy.

1. *Green M. A., Emery K., Hishikawa Y., Warta W., Dunlop E.* Solar cell efficiency tables (version 43) // Prog. Photovolt: Res. Appl.-2014.-**22.**-P. 1-9.
2. *Bohren C., and Huffman D.* Absorption and Scattering of Light by Small Particles (John Wiley & Sons, Inc. 1998), p. 544.