Photoconversion of the Plasmonic Solar Cells Based on ZnO Nanorods and Silicon with Silver and Gold Nanoparticles

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Quick development of new photovoltaic technologies encouraged the scientists to seek the new ways to improve their efficiency. One of the method frequently explored is plasmonics. The deposition of metal nanoparticles on top of a solar cell can cause the increase of the light absorption inside of the cell, which leads to higher photoconversion [1].

In our work we studied solar cells based on ZnO nanorods (NR), covered with silver nanoparticles (NPs) of diameters approximately 20 nm and gold of diameters approximately 10 nm, grown on the silicon substrate using the hydrothermal method. The nanorods were covered with ZnMgO and ZnO:Al layers using atomic layer deposition.

The sizes of the NPs were determined from the SEM images. Photovoltaic performance of the solar cells was analyzed using the spectral characteristics of the reflectance, sensitivity and external quantum efficiency. It was found that the sample with Ag NPs exhibits higher reflectance in the visible range than the reference sample without the NPs. Quantum efficiency is the highest for the sample with Au NPs in the whole measured spectrum of 300-1200 nm reaching 70%. The sample with Ag NPs exhibits lower quantum efficiency than the reference sample in the visible range of spectrum due to the increased reflectance. From the current-voltage characteristics under 1-Sun illumination the efficiency of the samples were obtained to be 4.45% for the reference sample, 4.6% for the sample with Ag NPs and 5.79% with Au NPs.

The gold nanoparticles of sizes approximately 10 nm are more promising in increasing the efficiency of the inorganic solar cells.

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