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ABSTRACT

The subject of the thesis are solar cells based on MoS_2 and TiO_2 heterojunctions. The main goal of the research presented in the work is to maximize the efficiency of solar energy conversion into electricity by optimizing the process of obtaining MoS_2 - TiO_2 heterojunctions using the quantum size effect in MoS_2.

The produced series of samples were characterized using the following methods: Raman spectroscopy, XRD diffraction, transmission electron microscopy TEM and UV-ViS optical spectroscopy. The efficiency of obtained solar cells was determined on the basis of measurements of the current - voltage characteristics. SIMS secondary ion mass spectroscopy was used to study the chemical composition and quality of the interfaces in produced solar cells.

It was observed that the energy gap of the MoS_2 increases with the decrease of the thickness of the MoS_2 layer and thus with the decrease of the average size of the MoS_2 crystallites. The justification for this relationship was attributed to the occurrence of the quantum size effect in thin MoS_2 films.

Due to the quantum size effect, the valence and conductivity levels in MoS_2 are well fitted to the energy levels in TiO_2 and P3HT. The highest efficiency of 2.62% was obtained for a solar cell based on a planar heterojunction with a layer thickness of 8nm for MoS_2 and 22nm for TiO_2. In case of cells based on bulk heterojunctions, the highest efficiency obtained was 1.63% for a cell based on a 7 nm thick MoS_2@TiO_2 heterojunction.

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