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Specific photoelectric and optical properties of CdS/CdTe film heterosystems with solid solution interlayers

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Spectral dependence of photosensitivity has been studied for ITO/CdTe/Au/Cu and ITO/CdS/CdTe/Au/Cu film heterosystems. When illuminated from the ITO side, ITO/CdS/CdTe/Au/Cu heterosystems show a photo-response maximum corresponding to absorption of 0.87 μm wavelength photons. This is due to formation of CdS_xTe_{1-x} solid solutions having the energy gap width less than that in CdTe layer. Basing on optical spectra of transmission coefficient, a photosensitivity range has been selected corresponding to the contribution of non-equilibrium charge carriers generated in the solid solution interlayer.

Исследована спектральная зависимость фоточувствительности пленочных гетеросистем ITO/CdTe/Au/Cu и ITO/CdS/CdTe/Au/Cu. При освещении гетеросистемы ITO/CdS/CdTe/Au/Cu со стороны ITO максимум фоточувствительности наблюдался при поглощения фотонов с длиной волны 0.87 мкм. Это обусловлено формированием твердых растворов CdS_xTe_{1-x} с шириной запрещенной зоны меньше, чем в слое CdTe. При исследовании оптических спектров коэффициента пропускания, был выбран интервал фоточувствительности, соответствующий вкладу неравновесных носителей заряда, генерированных в области варизонной прослойки твердых растворов.

The pCdTe/nCdS heterojunction is a great interest from the standpoint of thin-film solar element development. The theoretical efficiency of that heterojunction is 27 % [1]. It is also well-known that it is just the misfit between crystal lattice parameters of CdS and CdTe that is the main factor influencing negatively the parameters of a real nCdS–pCdTe heterojunction [1].

Consideration of literature data [2, 3] has shown that when developing photoelectric devices based on CdS/CdTe films, a great deal of attention is given today to the problem of possible presence of CdS_xTe_{1-x} solid solutions at the CdS–CdTe phase interface. Those solid solutions exhibit a band gap width different from those of CdS and CdTe layers [6]. Analysis of spectral dependences of photo-response and light absorption coefficient is among the most prompt methods to study the band gap width of semiconductors. Therefore, in this work, the CdS/CdTe film heterosystems were studied using photoelectric and optical methods to identify the solid solutions.

Glass substrates with deposited transparent conductive ITO layers were used to prepare CdTe-based heterosystems. 0.5 μm thick CdS layers were deposited onto ITO surface using the vacuum evaporation at 150°C. The CdS layers were recrystallized at 450°C. Then, 4 μm thick CdTe films were deposited onto CdS layers (when preparing ITO/CdS/CdTe heterosystems) or onto ITO surface (when preparing ITO/CdTe ones). The substrate temperature was 300 °C in all cases, the deposition was carried out without the vacuum deterioration. Then $CdCl_2$