Optical and photoelectric properties of the CdTe: Cu layer

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Introduction

Semiconductor thin-film solar cells with a multilayer structure are increasingly popular for obtaining renewable energy from solar radiation. The efficiency of solar cells can be significantly increased by controlled modification of the heterostructure [1].

Cadmium telluride with complex parameters such as an optimal band gap (1.45 eV), high absorption coefficient (10^5 cm^{-1}) and p-type of conductivity has proven to be an excellent material of the light absorber layer for photovoltaic applications. The high efficiency up to 21% of multilayer solar cells has been recorded based on CdTe / CdS [2].

Simulation

CdTe is a direct-band semiconductor that can have both n-type and p-type conductivity, depending on the use of appropriate alloying impurities [3]. Therefore, controlled doping of these materials with p and n-type of carriers we can significantly improve the efficiency of PV-modules based on them.

Fig. 1 shows the SCAPS solar cell definition panel, where specific parameters for each layer can be set. The conversion efficiency of solar radiation into photoelectric energy is determined by the width of the band gap of the studied heterostructure. SCAPS simulation tool allows to build appropriate band diagrams.

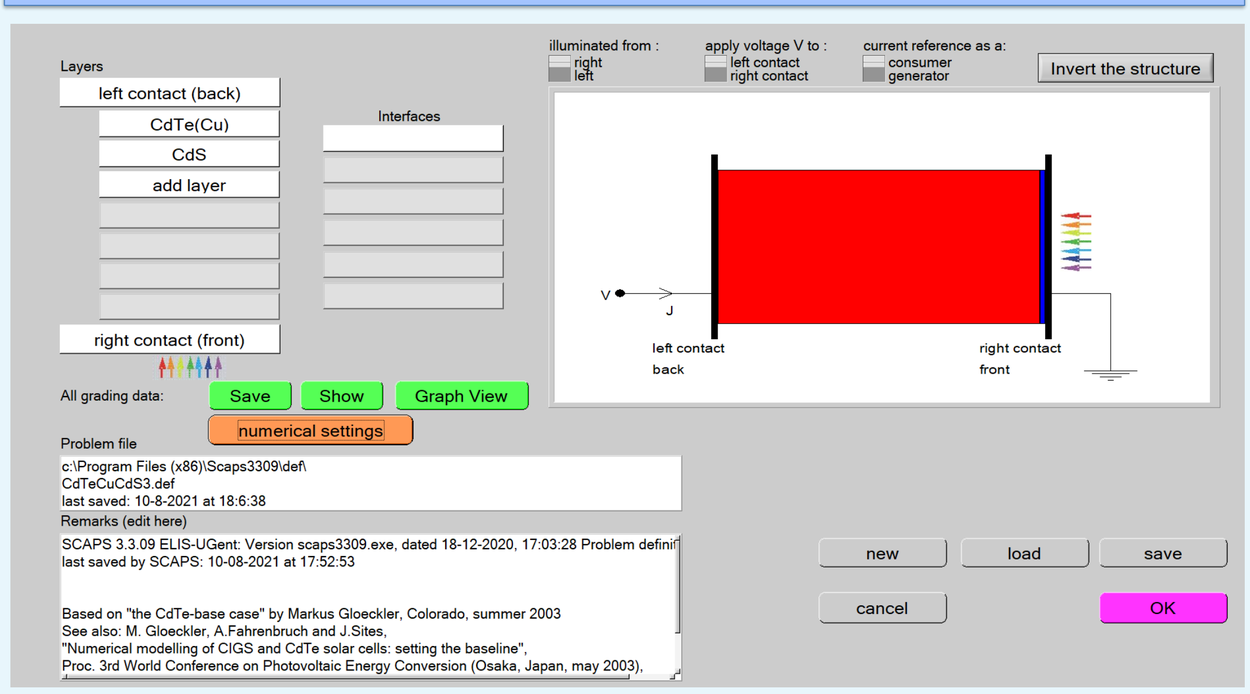

Fig. 1. SCAPS definition panel.

Table 1. Photovoltaic parameters of CdS/CdTe:Cu structures.

Samples	V_{oc} (V)	I_{sc} mA/cm^2	*FF*	η (%)
CdTe:Cu 2 wt.%	0.7512	31.232962	80.94	18.99
CdTe:Cu 3 wt.%	0.7651	31.233027	81.42	19.46
CdTe:Cu 4 wt.%	0.7691	32.695865	83.37	20.97

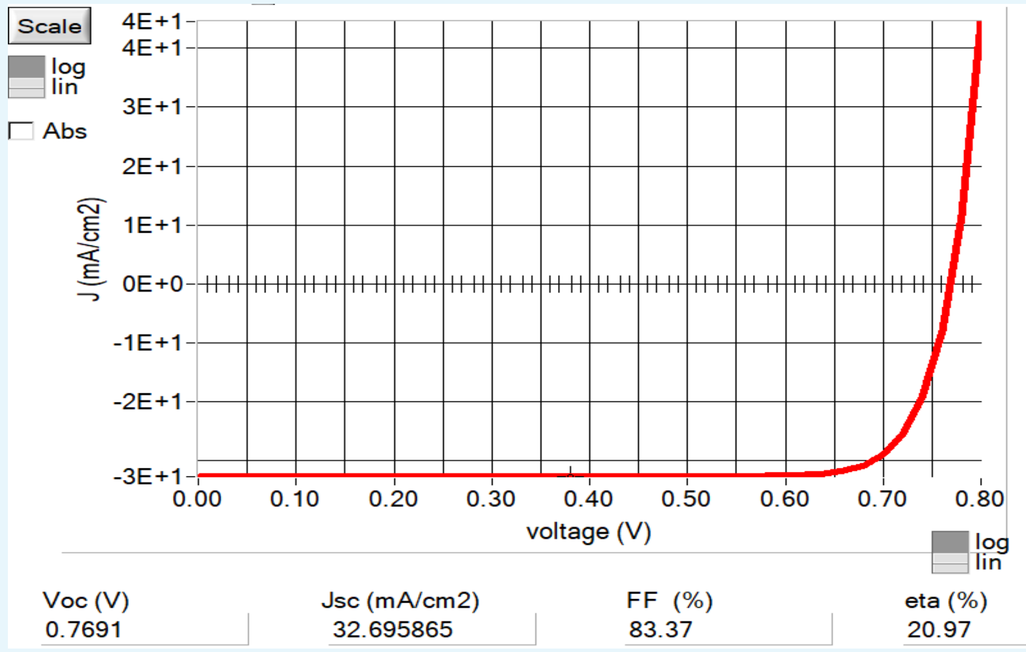

Fig. 2. Change in current density and power with anode voltage of CdS/CdTe: Cu (4 wt %) heterostructure solar cells.

Conclusions

The deposition technology is developed and the influence of copper impurity concentration on the electrical properties of CdTe thin films is studied. To obtain thin films, the method of open evaporation in vacuum is used, which ensures the purity of the film due to the high vacuum [4].

The study of the I-V characteristics of the heterojunction solar cell structures has shown a low efficiency of the solar cells, which might be due to the nature of the CdTe and CdS layers, the junction formation, and the grain boundary effects. Moreover, the efficiency is increased with increasing the Cu concentration. The study reveals that the solar cells prepared with 4 wt.% Cu addition possess the maximum conversion efficiency of 20.97 %.

References

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