CPPP 12 P **REFLECTIVITY SPECTRA OF $Cu_2ZnSnSe_4$**

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Recently a promising quaternary $Cu_2ZnSnSe_4$ compound absorber layers have attracted considerable interest due to their low cost, low-toxic and abundant elements. Thin film solar cells of $Cu_2ZnSnSe_4$ with efficiency exceeding 9 % have been fabricated so far [1]. In this paper we present reflectivity spectra measured at 300 K in the photon energy range of 1.5 - 6 eV. $Cu_2ZnSnSe_4$ crystals were grown by directional crystallization of the melt. The composition of the crystals was determined by the energy dispersive X-ray micro-analysis (EDAX). The average atomic ratio of Cu:Zn:Sn:Se was found to be close to stoichiometry. The reflectivity is measured using two-beam spectrometer Specord M-40.

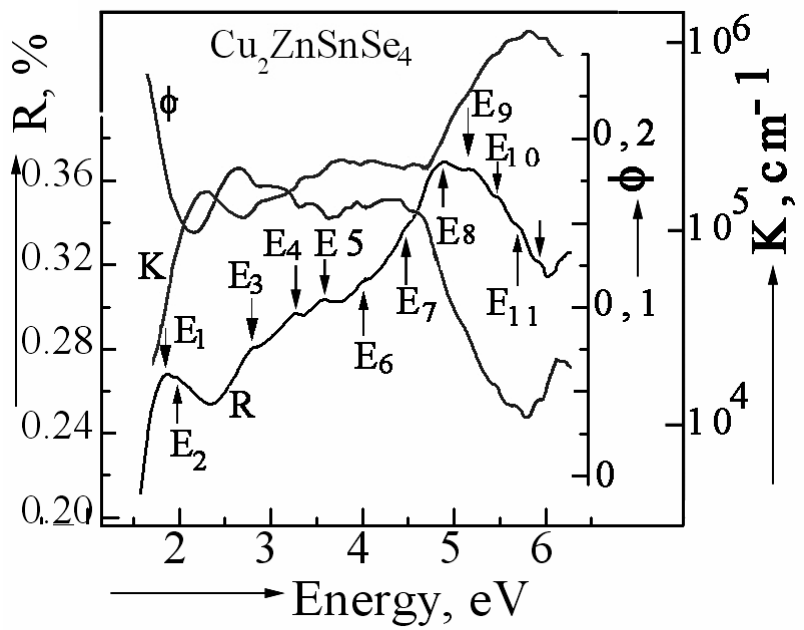

Fig.1 *Reflectivity spectra (R), the extinction coefficient (K) and phase of reflected ray (ϕ) vs energy.*

The $Cu_2ZnSnSe_4$ crystals show well pronounced structures of the reflectivity spectra in the range of $E > E_g$ at 300 K as presented in Fig.1. Up to 11 peaks are observed. By using the Kramers-Kronig relations the spectral dependences of the real ε_1 and imaginary ε_2 component of the complex dielectric function $\varepsilon(E) = \varepsilon_1(E) + i\times\varepsilon_2(E)$ has been calculated for the investigated materials. As a result, the energy band structure of $Cu_2ZnSnSe_4$ at photon energies higher than the fundamental band gap is derived from the analysis of the structures observed in $\varepsilon(E)$ spectra. Additionally, the spectral dependence of the complex refractive index, extinction coefficient and absorption coefficients of $Cu_2ZnSnSe_4$ crystals are determined in the 1.5-6 eV photon energy range.

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[1] I. Repins, C. Beall, N. Vora , C. De Hart, D. Kuciauskas, P. Dippo, B. To, J. Mann, Wan-Ching Hsu, A. Goodrich, R. Noufi, *Sol. Energy Mat. Sol. Cells* **101** (2012) 154