Physico-Chemical nanomaterials science

Influence of laser radiation on structural transformation in Cu_2ZnSnS_4 thin films

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Recently Cu_2ZnSnS_4 (CZTS) have attracted considerable attention as potential materials for new-generation of thin-film solar cells. The reasons of their convenient application are the suitable band gap energy of about 1.5 eV, high optical absorption coefficient, along with the fact that all constituents of CZTS are cheap, non-toxic and abundant in the Earth's crust.

The aim of this work is to investigate the influence of laser radiation on structural transformation of CZTS thin films. The films were deposited by flash evaporation of powdered ZnS, CuS and SnS binary compounds onto molybdenum-coated glass substrates at nominal substrate temperatures of 100 or 350°C. The obtained materials were thoroughly characterized by means of microscopic and spectroscopic methods. The main focus was on the stoichiometry of films.

In this work Raman spectra of Cu-rich CZTS thin films are discussed in connection with the non-stoichiometric composition and disordering within the cation sublattice of the kesterite. The shift of the main A-peak in Raman spectra from 338 to 332 cm^{-1} and its broadening are attributed to transition from the kesterite ($I\bar{4}$-symmetry) to the disordered kesterite structure ($I\bar{4}2m$-symmetry). It is shown that this transition may also be driven by an intense light, which possibly can stimulate transformation of Cu^{+}-ion to Cu^{2+}-ions and facilitates generation of Cu_{Zn}-defects on 2d-crystallographic positions.