High Vacuum Evaporation of n-CuIn₃Se₅ Photoabsorber Films for Hybrid PV Structures With Conductive Polymers

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Thin films of n-CuIn₃Se₅ photoabsorber were deposited onto glass / ITO substrates from polycrystalline bulk CuIn₃Se₅ source material by using the high vacuum evaporation technique. Thermal conditions for the substrates during evaporation process and following annealing in vacuum were selected with the purpose to prepare polycrystalline n-CuIn₃Se₅ photoabsorber layers for the hybrid photovoltaic structures based on inorganic photoabsorber and conductive polymer functional layers. It was found, that the CuIn₃Se₅ layers deposited at the temperature of substrate of 200 °C and annealed at the temperature range of 450–500 °C in vacuum demonstrate high photosensitivity and photoconductivity under white light illumination of 100 mW/cm² intensity. Obtained results show the chalcopyrite structure of prepared photoabsorber films with good adhesion to the glass / ITO substrate. The overall composition of deposited layers is close to the CuIn₃Se₅ stoichiometry. The as-deposited and annealed structures were investigated using the XRD spectroscopy, high-resolution SEM equipped with EDS, UV-VIS and Raman spectroscopy and I-V characteristics. On the basis of the impedance spectroscopy the average values of charge carriers concentration and profiles of charge carriers concentration in prepared photoabsorber layers were calculated.