Photoluminescence and structural properties of high quality CdSe films deposited by closed space vacuum sublimation

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CdSe films with direct bandgap energy about 1.75 eV at room temperature have *n*-type conduction and high photosensitivity in the visible spectral region. At present, such films are intensively studied. It is caused by the fact that they are suitable material for elaboration of a number of optoelectronic devices such as photoelectrochemical solar cells, photo- and gas detectors, high-performance thin film transistors, gamma ray detectors, light-emitting diodes, etc. Furthermore, CdSe thin films can also be used as the absorber layers in the top of tandem solar cells and they are considered to be an important material for photovoltaic applications.

In this work, we study the photoluminescence (PL) and structural properties of CdSe films deposited on the glass substrates by means of closed space vacuum sublimation technique. Comparison of the CdSe films PL properties deposited at different substrate temperatures with the results of the structural investigations allowed us to determine the optimal conditions of their deposition. The energy position of the exciton PL lines and the bands, caused by the donor-acceptor recombination, have been analysed as a function of the substrate temperature. This allowed to determine the nature and the energy structure of intrinsic and impurity defects as well as to evaluate the optical quality of the investigated thin films.

CdSe polycrystalline films were deposited on the glass substrates at the evaporator temperature T_e = 700 ^{0}C. The substrate temperature T_s varied from 200 ^{0}C to 600 ^{0}C, a growth time was 10 minutes. The films obtained at T_s < 400 ^{0}C have a highly dispersed structure with the grain size (d) from 0.1 μm to 3.0 μm. In this case the layer-by-layer mechanism determines the layers growth process. At $T_s \geq$ 400 ^{0}C the films have a columnar-like structure with the clear growth texture. For T_s = 600 ^{0}C the films with grain size D =(3-4) μm and layers thickness l = (5-6) μm were obtained. In this case the crystallites are preferentially oriented with the (102) planes parallel to the substrate.

The presence of a narrow intensive D^oX-line caused by the excitons bound to neutral donor in PL spectrum of CdSe films obtained at T_s = 600 ^{0}C indicates about the high optical quality of the investigated films which are n-type. Besides, another PL bands observed which are due to DAP recombination. It was shown that the donor and acceptor centers in CdSe films are mainly caused with Li(Na) resudial impurities.

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