

ELECTRONIC STRUCTURE OF TERNARY $Pb_{1-x}Cd_xTe$ CRYSTAL BY MEANS OF PHOTOEMISSION SPECTROSCOPY

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The nanostructures with a quantum dots are of grate interest of application as well in electronics (high electric conductivity and low thermo-conductivity) as in optoelectronics (infrared detectors). Highly promissible case is represented by the quantum dots of PbTe created in between the layers of CdTe as well as quantum dots of CdTe created in between the layers of PbTe [1]. The both crystals PbTe and CdTe are of different crystalline structure and their relative solubility is remarkably low. The PbTe belongs to the group o IV-VI narrow gap (0.23 eV) semiconductor compounds and crystallizes in the six fold coordinated lattice of rock salt while the CdTe belongs to the group of II-VI middle gap (1.45 eV) semiconductor compounds and crystallizes in four fold coordinated zinc blend lattice.

The bulk single crystals of $Pb_{1-x}Cd_xTe$, were grown in the Institute of Physics, Polish Academy of Sciences in Warsaw by physical vapor transport (PVT) method with proper quenching [2]. The frozen rock salt crystals of $Pb_{1-x}Cd_xTe$ ($x = 0.06, 0.08, 0.15$) about 1 ccm with (001) oriented natural facets were obtained. The X-ray diffraction studies of the crystals showed the reflections of a very good crystals.

The experiment was performed using the Tunable High Energy X-ray Photoemission Spectrometer (THE-XPS) at wiggler beam line station BW2 of the HASYLAB, DESY, Hamburg, Doris III storage Ring. Double crystal monochromator (Si(111) covers an energy range from 2.4 to 10 keV with a monochromatic photon flux of about 5×10^{12} photons/s and with total energy resolution power of 0.5 eV for radiation energy around 3000 eV. The station is adopted to perform the experiment with High-Energy X-ray Photoelectron Spectroscopy. The station E1 with the FLIPPER II monochromator was used to obtain

ultraviolet PES spectra. Tunable High Energy PES and Ultraviolet PES were applied to study the crystals spectra containing: valence band, Cd 3d and 4d, Pb 4f and 5d and Te 3d and 4d. The valence band density of states distribution spectra remarkably changes with the crystal composition. In most cases obtained valence band spectra of ternary crystal can be in first approximation treated as a sum of the components spectra. In the case of measured $Pb_{1-x}Cd_xTe$ ternary crystal this first order approximation does not follow the rule and inclination of ternary crystal spectra possesses some differences from the sum of spectra measured for crystal PbTe and CdTe. The core levels chemical shifts and appearance of shoulders of the core peaks were studied to illustrate the interaction with different nearest neighbors. X-ray diffraction studies recognized kind o defects suggesting the preference to create the dots of PbTe while the other defects can be correlated to the preference of CdTe dots creation.

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