Conference Abstracts

PS-11.01.13 Doping of Bi and Cd during Molecular Beam Epitaxial Growth of Pb-SnSe/Se. By Nakatani, Suzuki*, and Torao Seki, Department of Electronics, Tohoku Institute of Technology, Yagi, Yamada, Sendai 982, Japan, and Kenzo Watanuki, Research Institute of Electrical Communication, Tohoku University, Katahira, Sendai 980, Japan.

Pseudinary IV-VI compound semiconductors Pb-SnSe, as well as PbI₂-YSnF₆, are valuable as their applications to the infrared optoelectronic devices such as photovoltaic detectors and tunable laser diodes. It is because that they have a small direct energy gap and also the infrared wavelength region can be tuned by suitable compositions of Pb-I and Y-Se-Y-F. The crystal growth of these materials, however, is still an incomplete task. They have been grown by the molecular beam epitaxy (MBE) method with high-quality epitaxial layers being obtained. In this Letter, we report the crystal growth of Pb-SnSe and PbI₂-YSnF₆ by MBE. The growth rate of Pb-SnSe is about 1 monolayer per second, and that of PbI₂-YSnF₆ is about 2 monolayers per second. We adopted a Au buffer layer to improve the growth rate and obtain high-quality epitaxial layers. We also investigated the structural properties of the grown layers using X-ray diffraction and electron microscopy. The obtained results show that the grown layers are crystalline, and the structural properties are comparable to those of bulk Pb-SnSe and PbI₂-YSnF₆. We concluded that the MBE growth of Pb-SnSe and PbI₂-YSnF₆ is a promising technique for the fabrication of infrared optoelectronic devices.

PS-11.01.14 Surface Topography Due to Growth and Relaxation of InGaAs and InGaP Single Heteroepitaxial Layers. By H. Ohno, U. D. Schwartz, G. Wagner, V. Gopalan, and P. Pauly*, Inst. of Crystallography, Univ. of Leipzig, Germany, Inst. of Physics, Univ. of Basel, Switzerland. **Inst. of Crystallography, Univ. of Dresden, Germany.

InGaAs and InGaP single heteroepitaxial layers were grown by organometallic chemical vapour deposition on (001) oriented InP and GaAs substrates, respectively. The mechanical stress in the layers caused by the mismatch of the lattice constants of layer and substrate can be varied by changing the composition of the layer. In our case the layers were grown under tensile stress conditions. The defect structure in the layers was investigated by transmission electron microscopy (TEM) and cross-sectional TEM. Microstructural processes during the relaxation of strained layers and the topography of the (001) layer surface which can be observed by scanning force microscopy (SFM) in air. This technique allows surface imaging with a vertical and lateral resolution in the Angstrom region. The (001) InGaAs layer surface shows two characteristic features: straight grooves and steps parallel [110]. Results obtained from dislocation glide process on [111] planes and growth steps. Moreover, cracks parallel [110] were observed. Relaxation takes place during the growth of the layer. The influence of the relaxation caused steps and grooves on the growing process and the location of the growing steps was investigated. Growing steps with a height of 30-100 Å were observed. This step height corresponds to half the lattice constant of InGaAs. Dislocation glide processes in the InGaAs layers have been investigated and are of high interest. Dislocation glide processes are related to the dislocation structure in the InGaAs layers.


During deformation of semiconductor single-crystals at elevated temperatures (400-600°C) slip lines raise at the (001) and (110) surface as traces of different slip planes that can be detected by scanning force microscopy (SFM). We used a GaP:Te/Ge(001)GaP homoepitaxial layer system (grown by VPE technique) as a model substance because of its smooth surface and the transparency of GaP in visible light. Deformation was carried out on a 4-point bending stage adapted to a scanning force microscope described elsewhere (J. Solch et al., Z. Krist., 1980, 132, 201-218). SFM allows the determination of the steps and deflection microscopy. The resolution of the steps and deflections is determined by the atomic scale. The SFM images show that the steps are not simply due to the movement of individual dislocations but they are imaged by SFM for the first time. In addition, the long range order distribution of glide steps is detected by deflection microscopy.