11-Surfaces, Interfaces and Thin Films

PS–11.02.20 X-RAY SCATTERING TOPOGRAPHIC OBSERVATION OF MIGRATION ENHANCED EPITAXY GROWN GaAs LATTICE-MISMATCHED HETEROEPITAXIAL LAYER ON Si

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X-ray scattering topography, which the present authors proposed,[1,2] has been successfully applied to, lattice-mismatched heteroepitaxial layer systems, an MBE (molecular beam epitaxy) grown InAs on GaAs, MO-CVD (metal-organic chemical vapor deposition) grown GaAs on Si and InP on Si, of which systems have crystal mosaicities which gave a local rocking curve of X-ray diffraction as broad as several hundreds arc sec. Since, for such a locally imperfect crystal, conventional X-ray diffraction topography (e.g. Lang-camera) provides little significant information, X-ray scattering topography has been applied to characterizing lattice-mismatched heteroepitaxial layer systems. Microcomputer-assisted x-ray scattering topography has enabled us to observe a quantitative orientation distribution.[3,4] And crystallographical correlation between the epitaxial layers and substrates have been also discussed.[5-8] The result of MO-CVD grown GaAs on Si indicated the following. The bending was concave. The bending mechanism was explained primarily by the difference in thermal expansion coefficients between the epitaxial layer and the substrate. It was proposed that climb motion of misfit dislocation may cause the anisotropic lattice bending of the epitaxial layer.
In this congress we report the X-ray scattering topographic observation of MEE (migration enhanced epitaxy) grown GaAs on Si. The structures revealed were different from that of MO-CVD grown GaAs on Si. One of the feature of MEE growth method[9,10] exists in comparable lower growth temperature and the method made an epitaxial layer with lower dislocation density. It was found that the epitaxial layer and the substrate have lattice isotropically concave bend 3-4 arc min and 1-2 arc min, respectively, in a specimen of 6×6 mm^2 dimensions. Comparing the results of the previous MO-CVD grown GaAs on Si system,[7] the epitaxial layer and the substrate were concavely bent with 5-6 arc min and 2-3 arc min, respectively, of which lattice was bent around the different direction between the epitaxial layer and the substrate. It is suggested that on account of lower temperature growth the MEE gown epitaxial layers are smaller bending, and that amount of defects and motion of defects are smaller than those of MO-CVD grown one.

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PS–11.02.21

STM AND XRD STUDIES ON STRUCTURE OF AMORPHOUS INDIUM SELENIDE FILMS

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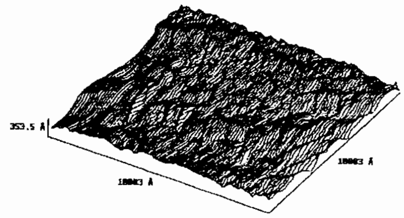
The surface structure of vapour deposited InSe films was observed by recording various images using a Scanning Tunneling Microscope. A through study of these images revealed that these films deposited at room temperature are amorphous. A columnar type of growth consisting of numerous flakes, arranged one after another with thickness around 40 Å and height around 300 Å was observed.



The growth direction is normal to the substrate. The column of flakes are in turn arranged step wise as shown in the figure.

X-ray diffraction intensities have been recorded and structure of these has been studied using radial distribution analysis technique. Inter atomic peaks are observed at r values equal to 2.70, 3.80,4.40, 5.30, 6.40, and 7.20 Å. The structure at r_1=2.70 Å and r_3=4.40 Å very nearly satisfies the ratio for a regular tetrahedron (r_1 =0.612r_3). r_1 =2.70 Å corresponds to the In-Se and r_2=3.80 Å corresponds to In-In bond length. r_3= 4.40 Å corresponds to Se-Se distances. The effect of annealing for different duration on the structure of the film has been investigated and it is found bond distances progressively approaches towards their corresponding crystalline values.

PS–11.02.22 STRUCTURE OF EPITAXIAL FLUORIDE THIN FILMS GROWN ON GaAs(111) SUBSTRATES

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X-ray standing waves (XSWs) and scatterings along the surface normal (XSASNs) were used to determine the atomic structure and stoichiometry of $CaSrF_2$/GaAs(111) and CaF_2/S/GaAs(111) heteroepitaxial interfaces at a synchrotron radiation source. Lattice-matched $CaSrF_2$ alloy films on the As surface of GaAs(111) have a high crystalline order with a first F monolayer missing at the heteroepitaxial interface. (Ca, Sr) atoms are located in the T sites on top of the first-layer As atoms with little random disorder in the vertical direction. Least-squares fits of the XSASN data favored missing first-layer As atoms (*T(miss.)* model) over As atoms shifted to the stacking-fault H3 sites (*T(shift)* model). The As-Ga double layers in the interface region are relaxed to the outward direction.

