depth profile the surface disorder and possible pressure induced phase transitions.

The results indicate that all of the studied compounds were changed due to the compression. The GID analysis shows that the surface regions of the compacted tolbutamide, carbamazepine and chlorpropamide tablets were disordered. The manifestations of the disordering in the diffractographs are the increased peak intensity and height and the decreased peak width. Moreover, a polymorphic phase transition was observed in chlorpropamide tablets. The biggest changes took place at the very surface of the tablets. The transitions were also dependent on the used compaction pressure.

Keywords: pharmaceuticals, grazing incidence diffraction, pressure-induced disordering

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Structural and Compositional Investigation of Semiconductor Quantum Materials

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The size, shape, strain distribution, compositional profile and spatial distribution are the critical factors determining the electronic level and thus the physical properties of semiconductor nano-structures. For those MBE-grown mesoscopic objects, lattice mismatch, surface segregation, interface diffusion and various kinetic effects make their formation mechanism very complicated. In fact, the structure and the formation mechanism of these self-assembled nano-structures are still not well understood. In this work, we applied grazing incidence X-ray scattering methods including reciprocal space map and small angle X-ray scattering to study the strain field, shape and spatial distribution of III-V semiconductor nano-structures. In particular, we will focus on the application of resonant X-ray scattering technique to accurately determine the compositional distribution within the nano-structures with high resolution.

Keywords: surface X-ray scattering, semiconductor epitaxy, nanostructures

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Structure Analysis of Crystal Grain Nearby Surface using X-ray Scattering at Small Glancing Angle of Incidence

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When X-rays are applied to the material surface at a grazing angle of incidence, the intensity of X-rays scattered on the surface is the sum of the X-rays that scattered by the atoms only on the surface, ca. several ten atomic layers deep, and the contribution of the atoms of each depth to the X-rays intensity varies on the incidence angles.

Since the penetration depth of X-rays changes by changing an incidence angle, a structural change of the depth direction of a material surface layer can be known in analyzing incidence angle dependence of the information that the scattered X-rays have.

We derived the x-ray intensity propagating during the surface layer materials that are characterized with complex refractive index, which changes continuously in depth, and studied analyzing method for evaluating the distribution of grain size of the crystal in the surface layer of material by using x-ray diffraction at small glancing angle incidence.

Intensities of the diffracted x-rays on polycrystalline iron surface were measured continuously at the various incidence angles, and the dependency of the incidence angles was investigated.

Keywords: surface X-ray scattering, polycrystalline X-ray diffraction, grazing incidence diffraction

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Probing Interface Strain With X-ray Bragg-Surface Diffraction

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Epitaxially grown Au films on semiconductor substrates, especially on GaAs single-crystals, have a wide variety of applications in the semiconductor industry. It has been yet very difficult to apply modern electron microscopy such as scanning tunneling microcopy and transmission electron microcopy in studying the interface structure since the interface is buried under an over-layer film. Moreover, the grazing incidence X-ray diffraction frequently used for characterization of surfaces/interfaces may encounter difficulties when the incident X-rays propagate from a lower refractive index medium into a higher one.

To overcome this difficulty, we adopt the three-wave Bragg-surface diffraction technique to investigate the effects of interface on the formation of diffraction images. From the angular positions of the diffracted images the variation of lattice constants parallel and normal to the interface can be determined. The experiment is carried out at NSRRC. The Bragg- surface diffraction used is the GaAs(006)/(1-13), where (006) is a symmetric Bragg reflection and (1-13) is a surface diffraction. The photon energy employed is 11.07 keV. Details about the analysis of strain will be reported.

Keywords: X-ray multiple diffraction, interface, strain

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Chemical Preparation of GaAs (100), (110), (111) and (112) Substrates with HF:H_2O_2: Citric Acid:H_2O

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Chemical preparation of GaAs (100), (110), (111) and (112) substrates was performed by HF:H_2O_2: Citric acid: H_2O solution. The removed layer thickness was evaluated as a function of the constituent concentrations, temperature and the etching time. HF concentration was varied from 0.065 to 5.2 mol, H_2O_2 was varied from 1.28 to 3.23 mol and citric acid ($C_6H_8O_7.H_2O$) concentration was maintained constant (1.3 mol) to obtain the etching rate. The temperature of etching was varied of room temperature to 75 °C for the same constituent concentration. The rate of etching and the surface quality were controlled by high resolution optical microscope.

Keywords: surface quality, chemical preparation, rate of etching

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The X-ray Reflectometry and the Phase Contrast Methods for Crystal Analysis

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The X-ray phase contrast method [1] provides high resolution visualization of the internal structure of low absorbing substances with flat density gradient. This method can also be used for the study of refraction index changing processes, e.g. crystal growth. NaCl solution, where the same crystals are grown, has been used as an investigated object. The results of experiments were the density gradient of the near-surface region around the growing crystals and the width of the intermediate layer.

The X-ray reflectometry methods provide estimating the physical and geometrical properties of the near-surface region of the crystals with a high accuracy. These methods are based on the measurement of