07.2-12 ASYMMETRIC X-RAY DIFFRACTION METHOD TO THE MEASUREMENT OF ELASTIC CONSTANTS FOR EPITAXIALLY GROWN SINGLE CRYSTAL.

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N. Kashiwagura, Y. Kashihara and J. Harada (Jpn. J. Appl. Phys. 25 (1986) 1317-1322) have recently demonstrated that a set of elastic constants can be determined within the accuracy of 8% even for an MBE grown $(Ga_{0.5}Al_{0.5})As$ mixed crystal of 4 μm thickness by a measurement of X-ray diffuse scattering and its analysis based on a least square fitting procedure. In the measurement of such diffuse scattering a symmetrical diffraction condition is usually employed where the angle between the scattered beam and the specimen surface is the same as that between the incident beam and the specimen surface. The thickness of the normal MBE grown crystal is, however, much thinner than 4 μm, and the background scattering from the substrate is considerably high. Because of that it was hardly expected to determine elastic constants even with an accuracy less than 15% for such thin crystals. The asymmetric diffraction condition was then examined by using a four circle diffractometer for the measurement of TDS from $(Ga_{0.65}Al_{0.35})As$ mixed crystals of 1 μm thickness. It turned out that the S/N ratio is greatly improved with the decrease of glancing angle. It is presented also the method to convent observed intensity into absolute units.

07.2-13 X-RAY DOUBLE CRYSTAL DIFFRACTION STUDY OF HOMOEPITAXIAL STRUCTURES FORMED ON POROUS SILICON.

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This study was undertaken to investigate the homoepitaxial structures formed by CVD method on the exotic surface of porous silicon. Such structures are very attractive for application in microelectronics due to unique properties of porous silicon produced by anodization.
The lattice parameters of the epitaxial and porous silicon layers, mechanical stresses and macrodeformations were determined by the X-ray double crystal diffractometry. Copper Kα radiation and fourth order reflection {(444),-(444)} from the (111) plane were used.
The relative compression of silicon lattice of $(1-2)\cdot 10^{-5}$ has been observed to appear in the epitaxial layers formed on porous silicon. The crystal lattice of porous silicon is found to be tetragonally distorted. In the direction normal to the surface the interplanar spacing of the porous silicon is increased for the samples before epitaxy but is decreased for the samples after epitaxy. The relative deformation of silicon lattice of $(2-4)\cdot 10^{-4}$ has been observed to appear in the porous layer depending both on the anodization and high temperature pre-epitaxial annealing regimes. The unexpectedly high values of the mechanical stresses of 10^{9} dyn/cm^2 were determined in the samples examined. A model based on the capillary mechanism and sintering theory has been developed to explain the experimental results.

07.2-14 THEORETICAL APPROACH TO EPITAXY OF PARTICLES

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Succeeding to Rhodin and Walton's approach to epitaxy (Single Crystal Films, by Francombe and Sato, Pergamon Press, 1964, p.31), another interpretation of epitaxy is proposed. And this is one of the interpretations of experimental results reported in Collected Abstracts (07,2-8) of 13th ICCG. Based on Walton's hypothesis about orientations, it is deduced that in case of depositions on the condition of constant incidence rate and substrate temperature, orientations of particles vary from not particular but different orientation from each other, so to speak, random to a (111) orientation and further to a (001) orientation with variation of substrate temperature. The transition temperature for the (111) epitaxy of particles is given by the equation $T_1 = (Qad+E_2)/k\ln(\nu N_0/R)$, which was already obtained by Rhodin and Walton and to which a new interpretation is given by the author. The transition temperature from (111) to (001) epitaxy of particles is given by the equation $T_3 = (Qad+E_3-E_2)/k\ln(\nu N_0/R)$.
Theoretically, an epitaxial temperature of particles may be interpreted as the particular temperature obtained by extrapolation of epitaxial transition temperatures dennoted by T_1 or T_3.
When an orientation of particles is dependent only on nucleation, epitaxial temperatures T_{1e} for (111) epitaxy of particles and T_{3e} for (001) epitaxy have been obtained in the first approximation as following:
$T_{1e} = E_2/k\ln(N_0/N_1)$, $T_{3e} = (E_3-E_2)/k\ln(N_0/N_1)$,
where E_2 is dissociation energy of the pair, E_3 is dissociation energy of the three atom nucleus, N_0 is density of adsorption sites and N_1 is density of monomer of adsorbed atoms.
The relations between the orientation of particles and substrate temperature are shown schematically in the Fig.