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Quantitative Analysis of Lattice Distortion due to Surface Treatment of Bias Sputtering by Extremely Asymmetric X-Ray Diffraction

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Introduction

Strain fields near InGaP or GaAs surfaces due to bias sputtering (Ar plasma-ion irradiation) for surface cleaning were measured by using a strain-sensitive X-ray diffraction technique. An extremely asymmetric InGaP or GaAs 113 reflection of the sample was measured to observe strain fields.

Results and Discussion

We found that strain fields near InGaP or GaAs surfaces due to bias sputtering are affected by the bias voltage (Ar plasma-ion irradiation energy) used in this surface-cleaning treatment.

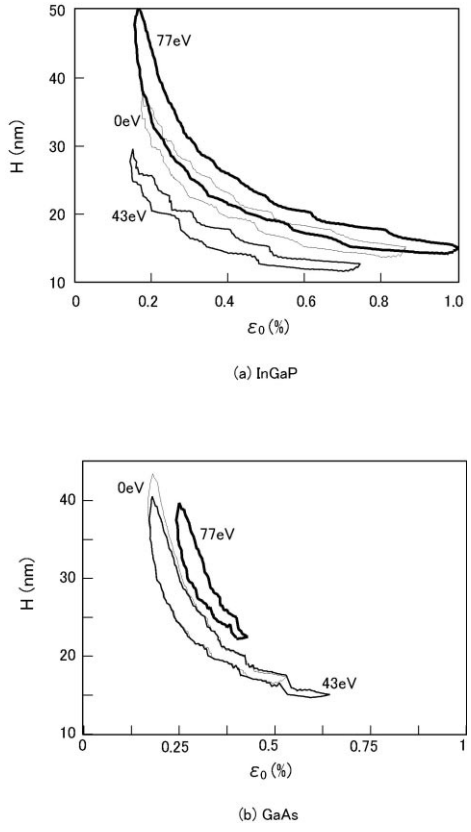

Fig. 1 Obtained Reliable regions of maximum strain (ε_0) and the thickness of the distorted layer (H)

By comparing measured 113 rocking curves and calculated ones based on the dynamical rocking curves and calculated ones based on the theory of X-rays, we estimated the thickness of a strained layer and a maximum strain at the surface, as shown in Fig. 1. In order to narrow the reliable region, X-ray wavelength dependencies of the integrated intensities have been measured as shown in Fig. 2. Resulting estimated parameters clearly show the bias sputtering to have two effects. One should be the surface cleaning process of removing oxides on surfaces. The other is the lattice expansion, which is caused by compositional fluctuation near the surface or peening process of Ar ion.

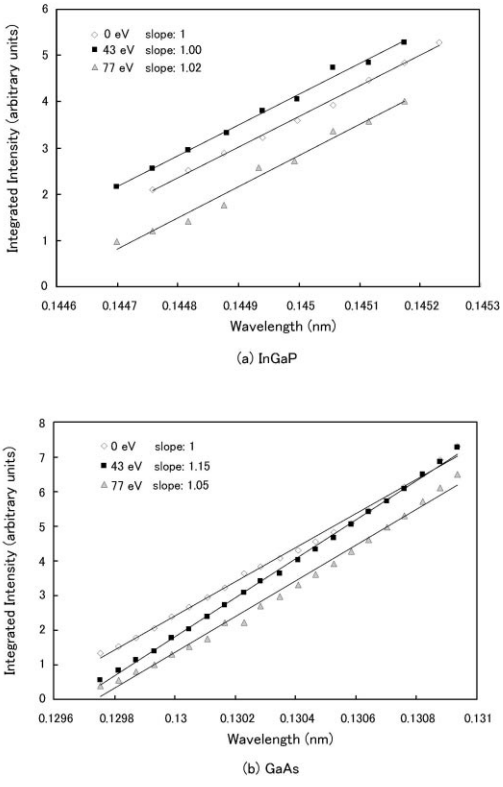

Fig. 2 Dependence of Integrated intensities for the measured rocking curves on X-ray wavelength

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