Evaluation of dislocation densities and their distribution in epitaxial (211) CdTe/ Si

Nagoya Institute of Technology
Bal Singh Chaudhari, Hayata Goto, Madan Niraula, Kazuhito Yasuda
E-mail: 30513009@stn.nitech.ac.jp

Introduction: Thick epitaxially grown CdTe layers on Si substrates are being used in large are X-ray, gamma ray detector development. However, CdTe epilayers on Si substrates consists large number of dislocations generated due to difference in lattice constant and thermal coefficient mismatch between CdTe and Si. These dislocations increase dark current and degrade device performance. In this work, we investigated propagation and distribution of dislocations in epilayers by examining epilayer of different thickness using etch pit density (EPD) and X-ray diffraction (XRD).

Experimental: Thick CdTe epitaxial layers grown on (211) Si substrates by metal organic vapor phase epitaxy (MOVPE) were used. These epilayers were successively etched in Br.- Methanol solution to make epilayers of different thickness. They were then etched in Everson etch solution (HF: HNO3: Lactic acid=1:4:25) and the pits formed on the surface was counted by using an optical microscope to estimate the dislocation density as a function of epilayer thickness. Crystal quality was also examined by using X-ray diffraction (XRD).

Results and discussion: Fig.1 shows optical images of the etched surface of CdTe epilayers of two different thicknesses. Triangular pits formed due to threading dislocations are clearly visible on the surface and the density of pits is lower for thicker sample. Fig.2 shows the EPD counts on the CdTe surface as a function of epilayer thickness. At first the EPD decreases rapidly with film thickness but slows down for epilayers of higher thickness. Similar results were observed in XRD measurements where DCRC FWHM value of CdTe decreases with epilayer thickness. Further results on EPD measurements and XRD as a function of epilayer thickness will be presented.

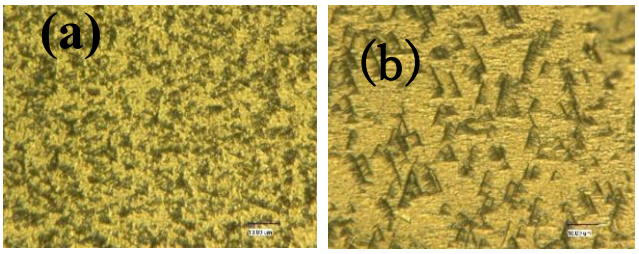

Fig. 1 Optical images (a) 6 μm and (b) 24 μm thick CdTe epilayers after Everson etching

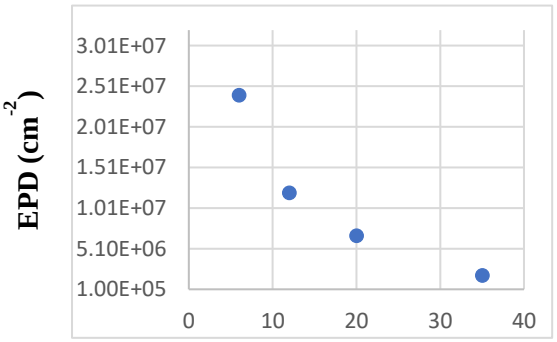

Fig. 2 EPD as function of CdTe film thickness.

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