STRAIN PROFILES IN 6H SiC CRYSTALS IMPLANTED WITH 160 keV H^+ IONS

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Silicon carbide is a perspective material for application in technology of high temperature semiconductor devices and for GaN based blue light optical elements. It is also a semiconductor with physical and material properties differing very much from the previously dominating ones and yet not very well known. The application of SiC in electronic industry increases systematically. The implantation technique is used in many technological applications. On this reason the systematical studies of implantation effect are very important.

It was well established that the effective evaluation of implantation induced strain profile is possible when a distinct interference effects are observed in X-ray diffraction patterns. To achieve this goal the implantation was performed in highy in highly perfect {00.1} oriented 6H SiC wafers manufactured by Cree. The samples were implanted with 160 keV H^+ ions to the fluencies 2×10^{15} cm^{-2} and 5×10^{15} cm^{-2}. They were examined before and after implantation with a number of synchrotron X–ray methods and Rutherford back scattering. The X–ray methods of characterization included the investigation of rocking curves recorded with a small 50×50 μm^2 probe beam and white beam Bragg case section and projection topography.

The synchrotron topographic examination performed before the implantation confirmed a high perfection of the samples containing well resolved individual dislocations of the density smaller than 10^3 cm^{-2}. The use of numerical simulation of topographic images confirmed the dominating concentration of screw dislocations along [00.1] direction. The implanted layers provided distinct interference effects in the rocking curves and Bragg-case section topographs (strain modulation fringes) [1]. Good visibility of interference maxima enabled effective evaluation of the strain profile by fitting the theoretical rocking curves to the experimental ones. The evaluated strain profiles approximated by browsed Gaussian curve were similar to the distribution of point defects calculated with SRIM2000. The profiles were similar to the distribution of defects numerically calculated from the channeling measurements.

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References

[1] K. Wieteska, W. Wierzchowski, W. Graeff, G. Gawlik, "X–ray synchrotron diffraction studies of $A^{III}B^{V}$ semiconductor compounds implanted with hydrogen", *phys. stat. sol. (a)* **203** (2006) 227-235.

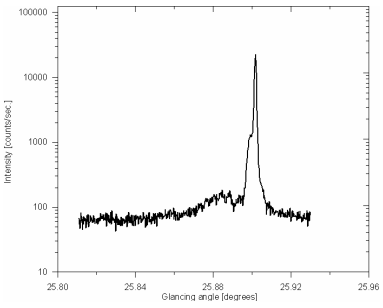

Figure 1. Experimental rocking curve of 6H SiC implanted with 160 keV H^+ ions to the dose 5×10^{15} cm^{-2} in 00.12 reflection of 0.1115 nm radiation.

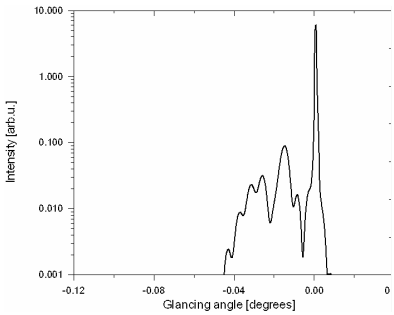

Figure 2. Theoretical rocking curve corresponding to the experimental one shown in Fig. 1.

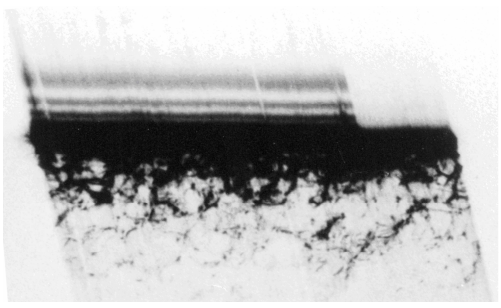

Figure 3. Strain modulation fringes revealed in Bragg-case section synchrotron topographic image of the same sample as in the case of Figure 1.