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COMPOSITION AND STRUCTURE OF CZOCHRALSKI SILICON IMPLANTED WITH H_2^+ AND Mn^+ AND ANNEALED UNDER ENHANCED HYDROSTATIC PRESSURE

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Depth distribution of implanted species and microstructure of oxygen-containing Czochralski grown silicon (Cz-Si) implanted with light (such as H^+; Si:H is important for so called smart cut processing [1]) or heavy ions (such as Mn^+; Si:Mn is considered as promising material for spintronics [2]) are strongly influenced by hydrostatic pressure (HP) applied during the post-implantation treatment.

Composition and structure of Si:H (prepared by implantation of Cz-Si with H_2^+; dose, $D = 1.7\times10^{17}$ cm^{-2}, energy, E = 50 keV, (projected range of H_2^+, R_p(H) = 275 nm) and of Si:Mn (implantation with Mn^+; $D = 1\times10^{16}$ cm^{-2} , E = 160 keV, R_p(Mn) = 140 nm), processed at up to 923 K under Ar pressure up to 1.2 GPa for up to 10 h, were investigated by ERD, RBS, and photoluminescence methods.

The defect structure of Si:Mn was also investigated by synchrotron diffraction topography at HASYLAB (Germany). High sensitivity to strain associated with small inclusions and dislocation loops was provided by monochromatic (l = 0.1115 nm) beam topography. High resolution X-ray diffraction was also used.

As it follows from ERD measurements (Fig. 1), HP applied during annealing of Si:H at 723--923 K affects strongly the distribution of implanted hydrogen preventing in part its out-diffusion.

Processing of Si:Mn under HP at up to 920 K for up to 10 h did not produce resolved structure defects. On the other hand, just such processing results in magnetic ordering [3]. Synchrotron topography made it possible to detect strains and large defects related to Si:Mn sample bending and unhomogeneity.

References

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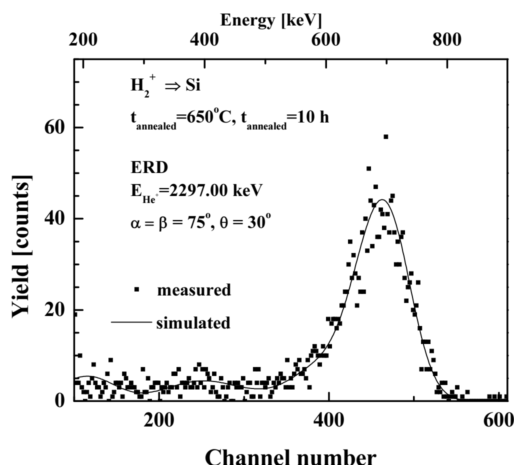

Figure 1. Typical spectrum of hydrogen measured by ERD methods.