X-ray Investigation of Hydrogen Implanted GaAs

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Smart-cut is a layer transfer technique, which offers a route to the monolithic integration of dissimilar materials. The technique exploits hydrogen implantation-induced exfoliation and wafer bonding to transfer thin layers of a semiconductor onto another material, which may have a different lattice constant. However, it is still unclear exactly how smart-cut is affected by different ion implantation parameters, especially for III-V materials such GaAs. This work aims to investigate the role of the implant temperature and the dose rate on blistering in GaAs, in order to reconcile these findings, and to further the understanding of the smart-cut process.

Semi-insulating GaAs wafers were implanted with 190 keV H_2^+ ions, to a fluence of $5x10^{16}$ H/cm^2, at sample temperatures of 180K, 300K, 470K and 570K. The distribution of hydrogen and the implantation damage in the samples were studied by ion beam analysis and X-ray high-resolution diffraction. Information concerning the ion implantation damage and the strain distribution in the film was obtained by simulating the X-ray diffraction pattern. It was found that at higher temperature, hydrogen is mobile in the lattice and can rearrange into the plates, microcracks and bubbles, which are presented in blisted material, thus relieving the strain in the lattice. The dose rate was also found to be significant for the smart-cut process, as blistering and exfoliation are inhibited at low dose rates.

Keywords: smart-cut, x-ray diffraction, ion implantation