DEFECT STRUCTURE OF CZOCHRALSKI GROWN NITROGEN DOPED SILICON ANNEALED UNDER ENHANCED PRESSURE

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Keywords: silicon, defect structure, topography, diffraction

Microdefects and their distribution in oxygen-containing Czochralski grown silicon (Cz-Si) are strongly influenced by the presence of nitrogen [1]. Annealing of nitrogen-doped Cz-Si:N at high temperatures (HT) results, first of all, in precipitation of oxygen interstitials, O_i's, also dependent on hydrostatic pressure (HP) applied at processing [2].

The defect structure of Cz-Si:N samples with N concentration, $c_N \leq 5\times10^{14}$ cm^{-3}, was investigated in this work after processing 2 mm thick Cz-Si:N samples at HT $\leq$ 1400 K under HP $\leq$ 1.1 GPa. About 150 μm thick near-surface layer was removed after processing from the Cz-Si:N surface by chemical polishing.

The defect structure of Cz-Si:N was investigated by synchrotron diffraction topography at the F1 and E2 experimental stations of the DORIS III synchrotron in HASYLAB (Germany). White and monochromatic (λ = 0.1115 nm) beam topographic methods in the Bragg geometry were used. Section topography (with the application of a fine 5 μm slit and glancing angle of 5) enabled indication of volume character of the defect distribution. High sensitivity to strains associated with small inclusions and dislocation loops was provided by monochromatic beam topography.

Also high resolution X-ray diffraction (recording the ω and $2\theta/\omega$ scans in the triple axis configuration of diffractometer), photoluminescence and IR absorption methods were used during our research.

Nitrogen admixture prevents formation of extended defects at processing done under 10^5 Pa. Such defects are created, however, in Cz-Si:N processed at first at 920 K under 10^5 Pa (to create nucleation centres for oxygen precipitation) and next at 1270 K / 1400 K under HP.

Annealing of nitrogen doped Czochralski grown silicon at 1230–1400 K under HP results in a creation of specific structure; numerous oxygen– and/or nitrogen-containing clusters are created. Investigation of the temperature–pressure effects in nitrogen-doped Cz-Si contributes in understanding the role of nitrogen in doped silicon considered for application in microelectronics.

References

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