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DEFECTS IN Si-Ge ANNEALED UNDER HIGH HYDROSTATIC PRESSURE

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Silicon-germanium single crystals (Si-Ge) are of growing interest, mostly because of their application in optoelectronics [1]. Even in the case of low Ge content, such wafers indicate the presence of growing bands related to non-uniform Ge distribution.

Annealing of Si-Ge (grown by the Czochralski method), especially under enhanced pressure of inert gas ambient (HP), results in transformation of its defect structure [2]. This effect is related to precipitation of interstitial oxygen (O_i) always present in such material.

The defect structure of Si-Ge samples with different Ge and O_i contents (Table 1), subjected to processing for 5 h at up to 1400 K under HP up to 1.1 GPa, has been investigated by synchrotron (at HASYLAB), high resolution X-ray, photoluminescence (PL) and infrared (IR) methods.

Synchrotron topographs of as grown and processed Si-Ge revealed the presence of dense growth bands (Fig. 1) connected with segregation of Ge, and dislocations, often forming the glide bands. The dislocation density exceeded 10^3 cm^{-3}; most of dislocations exhibited features related to their decoration with impurities.

Annealing at 1270 / 1400 K under 10^5 Pa resulted in markedly increased lattice parameter, *a*, caused, probably, by re-distribution of Ge in the Si-Ge lattice improving its homogeneity. The same processing under HP also resulted in changed *a* (Fig. 2). This change is related to partial HP-induced precipitation of O_i's, as confirmed also by PL and IR measurements. Both, oxygen precipitation and sample homogenisation, are observed after processing of Si-Ge, especially under HP.

Table 1. Investigated Si-Ge samples: content of Ge, orientation, and concentration of O_i, c_o ($\times10^{17}$ cm^{-3}).

at. % of Ge	orientation	c_o
1.4×10^{-3}	001	6.5
1.4	111	9.0
1.8	111	10
2.6	111	8.0

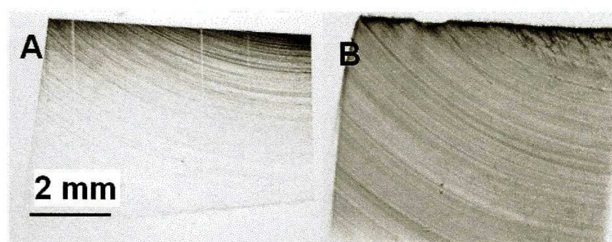

Figure 1. Bragg case synchrotron section (A) and projection (B) topographs of $Si_{0.982}Ge_{0.018}$ annealed at 1400 K under 10^5 Pa.

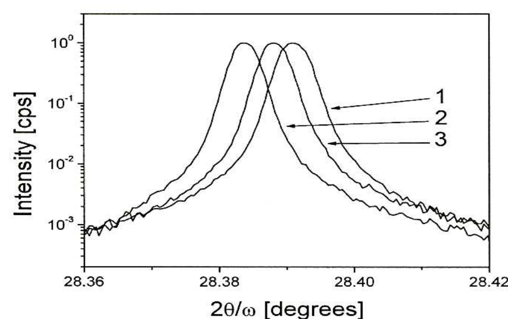

Figure 2. $2\Theta/\omega$ scan (111 reflection) for $Si_{0.986}Ge_{0.014}$: 1 – as grown; 2, 3 – processed for 5 h at 1270 K under 10^5 Pa (2) or 1.1 GPa (3).

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