Poster Presentation

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About precipitates in boron doped Si investigated by dynamical X-ray diffraction

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Thickness-dependent Pendellösung oscillations as described in the dynamical theory of diffraction are highly sensitive to strain fields from defects in a host crystal. Based on this, we present a novel approach to determine the precipitation kinetics of oxygen in silicon (Si) at the early stages of clustering at high temperatures. We present in-situ measurements up to 1100°C performed with the characteristic Kα1-line at 59.31 keV. The extracted static Debye-Waller factors are evaluated as a function of annealing time within a diffusion limited model of growing spherical precipitates. We investigated moderately p- ([B] ≈ 1015 1/cm³) and highly p+ ([B] ≈ 1018 1/cm³) boron doped Czochralski Si crystals at different nucleation and growth temperatures to determine the nucleation and precipitation kinetics as well as the long time precipitation behavior. At 650°C the diffusion constant found is enhanced compared to the extrapolated value for normal diffusion [1], and it is one order of magnitude lower compared to SIMS data [2]. However, it is close to the value obtained from dislocation unlocking experiments [3]. Moreover, the nucleation rates in p+ material are enhanced at 450 °C and 780 °C compared to the p- samples. The acceleration at 450 °C can be explained with boron enhanced oxygen dimer diffusion, whereas the nucleation rate at 780 °C is much too high to be accounted for by the enhanced oxygen dimer diffusivity alone. An analysis of the misfit strain yields a platelet morphology of the precipitates with a higher aspect ratio in the p- than in the p+ case. The long time precipitation behavior at 900 °C shows a second growth regime of comparable amplitude in both materials. This can be interpreted as Ostwald ripening and gives access to the surface energy of the precipitates.

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