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Effects of High-Temperature Annealing on the Microstructure and Mechanical Properties of β-Ga_2O_3:Fe Crystals

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Abstract. In this work, the microstructure and mechanical properties of bulk β-Ga_2O_3:Fe (0.01 mol.%) crystals were investigated using X-ray diffraction, optical transmission spectroscopy, and the ultrasonic composite oscillator technique at successive stages of two-step annealing at 1400 °C in air. Rocking curves revealed a substantial microstructural evolution, with a more complex profile envelope after 6 hours of annealing and a significant narrowing accompanied by increased reflection intensity after 12 hours. Optical transmission spectra showed an increase in transmittance below 650 nm and a decrease in the long-wavelength region. The amplitude dependences of internal friction and the effective elastic modulus were obtained and characterized. Changes in the microplastic yield point under oscillatory deformation and in the background values of these quantities were observed, indicating a reduction in the concentration of mobile defects and microstructural ordering. The effective elastic modulus measured in β-Ga_2O_3:Fe (0.01 mol.%) crystal after annealing along the [100] direction was found to be 339.8 GPa.

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