Temperature-dependent thermal conductivity in Mg-doped and undoped $\beta$-Ga$_2$O$_3$ bulk-crystals

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Invited Article

Short Abstract

Gallium oxide ($\beta$-Ga$_2$O$_3$) is one of the few conducting transparent oxides, yet only little is known concerning its thermal properties, especially the thermal conductivity $\lambda$. Here, the thermal conductivity is measured by applying the electrical 3$\omega$-method on Czochralski-grown $\beta$-Ga$_2$O$_3$ bulk crystals. The thermal conductivity increases for decreasing temperature while the phonon contribution of $\lambda$ dominates over the electron contribution below room temperature. The observed function $\lambda (T)$ agrees with phonon-phonon-Umklapp scattering, of which a detailed discussion for $T < \theta_D$ (Debye temperature) is provided.

![Graph showing temperature-dependent mean free path of phonons in Mg-doped and undoped $\beta$-Ga$_2$O$_3$ crystals.](image)

**Above**: The temperature dependent mean free path of phonons in the insulating Magnesium-doped $\beta$-Ga$_2$O$_3$. The solid line is the theoretical contribution for phonon-phonon-Umklapp scattering and the dashed line shows additionally a contribution of a second scattering process with a constant mean free path of 1.5 $\mu$m. The dotted line describes point-defect-scattering within the scope of Rayleigh scattering.