Temperature-dependent thermal conductivity and diffusivity of Mg-doped insulating \(\beta\)-Ga\(_2\)O\(_3\) single crystal along [100], [010] and [001]
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Short Abstract

The monoclinic crystal structure of \(\beta\)-Ga\(_2\)O\(_3\) leads to significant anisotropy of the thermal properties. The 2\(\omega\)-method is used to measure the thermal diffusivity \(D\) in [010] and [001] direction and to determine the thermal conductivity values \(\lambda\) of the [100], [010] and [001] direction from the same insulating Mg-doped \(\beta\)-Ga\(_2\)O\(_3\) single crystal. We detect a temperature independent anisotropy factor of both the thermal diffusivity and conductivity values of \(D_{[010]}/D_{[001]} = \lambda_{[010]}/\lambda_{[001]} = 1.4 \pm 0.1\). The temperature-dependence is in accord with phonon-phonon-Umklapp scattering processes from 300 K down to 150 K.

*Above.* a) An arrangement of two line heater pairs on top of the Mg-doped \(\beta\)-Ga\(_2\)O\(_3\)-crystal. b) The anisotropic thermal conductivity measurement setup to measure the temperature ow between two metal lines (Au) through the \(\beta\)-Ga\(_2\)O\(_3\)-crystal with a thickness of \(t = 0.5\) mm.