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Mechanical Vibrations Modeling and Analysis in Bulk Gallium Oxide Crystal

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Abstract. This study focuses on the characterization of elastic properties of β-phase gallium oxide crystals by the finite element method and the composite oscillator technique. The representative values of the elastic constants were obtained by the generalized gradient approximation as follows: $C_{11} = 250.4$ GPa, $C_{12} = 132.3$ GPa, $C_{13} = 148.8$ GPa, $C_{15} = –19.6$ GPa, $C_{22} = 357.1$ GPa, $C_{23} = 101.1$ GPa, $C_{25} = 16.4$ GPa, $C_{33} = 334.5$ GPa, $C_{35} = 4.5$ GPa, $C_{44} = 64.4$ GPa, $C_{46} = 27.2$ GPa, $C_{55} = 69.1$ GPa, and $C_{66} = 99.8$ GPa. Room-temperature composite oscillator measurements gave a resonance frequency of 107954 Hz and a logarithmic decrement of $2.59 \cdot 10^{-4}$, in good agreement with the finite-element prediction of a longitudinal resonance near 108624 Hz and with the assumed loss factor. These results provide the scientific benchmark for studying elasticity and microplasticity of β-Ga_2O_3 by acoustic resonance techniques.

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