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Title:Nonlocal host isotope effect in silicon: high-resolution spectroscopy of the 29 cm⁻¹ oxygen vibrational line
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Abstract:To investigate a possible host isotope effect on the local-mode-coupled low-energy two-dimensional motion of interstitial oxygen in silicon, we have measured the resonance parameters of the lowest transition of the 29cm⁻¹ band of the Si-O-Si complex in three samples of natural silicon (^{nat}Si) and in isotopically enriched ²⁸Si and ³⁰Si at temperatures between 5 and 50 K by means of coherent-source terahertz spectroscopy. At 5 K the resonance frequencies are 29.220±0.003, 29.240±0.003, and 28.820±0.006cm⁻¹ and the line widths are 0.11±0.01, 0.10±0.01cm⁻¹, and 0.07±0.01cm⁻¹ for ^{nat}Si, ²⁸Si, and ³⁰Si, respectively; samples with similar oxygen content. The frequency of the resonance maximum in ^{nat}Si is clearly downward shifted from that of ²⁸Si, though 85.2% of the Si-O-Si in ^{nat}Si consist of ²⁸Si pairs. From this observation and the fact that not only the lines in the isotopically enriched samples but also in natSi can be fitted by single Lorentzians we conclude that shift and width of the ^{nat}Si-resonance is not due to the Si isotopes in the Si-O-Si complex but to an average effect of the isotopically inhomogeneous lattice.
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Inspec controlled terms:elemental semiconductors - interstitials - isotope effects - localised modes - oxygen - silicon - terahertz wave spectra
Uncontrolled terms:nonlocal host isotope effect - high-resolution spectroscopy - oxygen

vibrational linewidth - local-mode-coupled low-energy two-dimensional motion - interstitial oxygen - resonance parameters - Si-O-Si complex - natural silicon - isotopically enriched silicon - coherent-source terahertz spectroscopy - resonance frequencies - oxygen content - single Lorentzians - resonance shift - resonance width - isotopically inhomogeneous lattice - temperature 5 K to 50 K - wave number 29 cm⁻¹ - Si:O

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Numerical data indexing:temperature 5.0E+00 5.0E+01 K;wavelength 3.448276E-04 m
Chemical indexing:Si:O/bin Si/bin O/bin Si/el O/el O/dop
Treatment:Experimental (EXP)
Discipline:Physics (A)
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