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Isotopic disorder in Ge single crystals probed with 73Ge NMR

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Abstract

NMR spectra of 73Ge (nuclear spin I=9/2) in germanium single crystals with different isotopic compositions have been measured at the frequency of 17.4 MHz at room temperature. Due to the small concentration (~0.1%) of the magnetic (73Ge) isotope, the magnetic dipole-dipole interaction is negligible in the samples studied, and the observed specific features of the resonance line shapes (a narrow central peak and a wide plateau) are determined mainly by the quadrupole interaction of magnetic nuclei with the random electric-field gradient (EFG) induced by the isotopic disorder. The second and fourth moments of the distribution function of the EFG are calculated taking into account local lattice deformations due to mass defects in the close neighborhood of the magnetic nuclei, as well as charge-density redistributions and lattice strains induced by distant impurity isotopes. The simulated line shapes, represented by a superposition of Gaussians corresponding to individual transitions between nuclear Zeeman sublevels, agree reasonably well with the measured spectra.