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73Ge NMR spectra in germanium single crystals with different isotopic composition

Verkhovskii S., Yakubovskii A., Trokiner A., Malkin B., Saikin S., Ozhogin V., Tikhomirov A., Ananyev A., Gerashenko A., Piskunov Y.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

We have studied the influence of isotopic disorder on the local deformations in Ge single crystals from both experimental and calculation points of view. The nuclear magnetic resonance (NMR) spectra of 73Ge nuclei (the nuclear spin equals 9/2) in perfect single crystals of germanium with different isotopic content were measured at temperatures 80, 300 and 450 K. Abnormal broadening of the spectrum was found to occur when the magnetic field was aligned along the [111] axis of a crystal. The observed specific angular dependence of the quadrupole broadening was attributed to isotopic disorder among atoms of germanium sited around the 73Ge NMR probe. Local lattice deformations in germanium crystal lattice due to isotopic impurity atoms were calculated in the framework of the adiabatic bond charge model. The results obtained were applied to study random noncubic crystal field interactions with the nuclear quadrupole moments and corresponding effects in NMR spectra. Simulated second and fourth moments of resonance frequency distributions caused by the magnetic dipole-dipole and electric quadrupole interactions are used to analyze the lineshapes, theoretical predictions agree qualitatively with the experimental data. © Springer-Verlag 1999.