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Multifrequency EPR spectroscopy of Ho3+ ions in synthetic forsterite

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Abstract

Electron paramagnetic resonance (EPR) of Ho3+ single ions and Ho3+-Mg2+-vacancy-Ho3+ associates in holmium-doped forsterite single crystals are studied at 9.4, 37.3 and 65-250 GHz. Crystals were grown from melt by the Czochralski technique in slightly oxidizing atmosphere. For both centers, directions of the principal magnetic axes and parameters of the effective spin Hamiltonians describing dependences of electron-nuclear levels on applied magnetic field are obtained. For Ho 3+ substituting Mg2+ in the M2 site as the single ion and for Ho3+ ions in dimer centers, values of crystal field parameters related to a real crystal lattice structure are estimated in the framework of the exchange charge model. The calculated crystal field energies, values of the g-factors of the ground Ho3+ quasi-doublet and the directions of the corresponding magnetic moments agree satisfactorily with the data obtained from measurements of EPR and optical absorption and site-selective luminescence spectra.