Crystal Field Analysis and Electron-phonon Coupling in Sc$_2$O$_3$:Cr$^{3+}$

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Crystal field analysis of the energy level structure of the Cr$^{3+}$ ion in the Sc$_2$O$_3$ crystal is performed, using the exchange charge model of the crystal field theory. The crystal field parameters acting on the optical electrons of the Cr$^{3+}$ ion at the sites with C$_2$ and C$_{3i}$ symmetry are calculated from the crystal structure data. On the basis of the comparison between experimental absorption and emission spectra and theoretically calculated energy levels of Sc$_2$O$_3$:Cr$^{3+}$, the conclusion is made that the spectroscopic properties of the title host are determined by the Cr$^{3+}$ ion at the positions of C$_2$ local symmetry. The Stokes shift $S = 4.32$ and the energy of the phonons effectively interacting with an impurity center $\hbar \omega = 499$ cm$^{-1}$ are derived from the experimental spectra of absorption and emission.

Key words: Crystal Field Theory; 3d-ions; Electron-phonon Coupling.