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Luminescence properties of Ni^{2+} in CsCdBr_3

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Optical properties of Ni^{2+} ions substituted in CsCdBr_3 crystal have been investigated from 9 to 300 K. Strictly forbidden transitions for spin, electric, or magnetic dipole selection rules in a purely cubic environment are observed in the absorption spectrum. The interpretation of these spectroscopic features is performed on the basis of trigonally distorted symmetry of the Ni^{2+} site and by taking into account the first-order spin-orbit interaction. In this framework, the cubic spin-orbit sublevels undergo further splitting due to the trigonal field. The energy-level calculation performed in this model agrees fairly well with experimental values.

The trigonal-field parameter is estimated to be -780 cm^{-1} . A better accuracy in the trigonal sublevels energies is obtained by taking into account the emission data. Four emission bands were observed in the $0.9\text{-}2.6 \mu\text{m}$ spectral range. These are ascribed to radiative deexcitation from the $^1\text{T}_2$ excited state to the lower excited states $^3\text{T}_2$, $^3\text{T}_1$, ^1E for the higher-energy transitions, and from the $^3\text{T}_2$ level to the ground state for the lower-energy emission. The temperature dependence of the lifetimes was fitted by the Mott law and in the Struck and Fonger model. On the basis of the latter model, decay processes are proposed.