

Trends in Hamiltonian parameters determined by systematic analysis of f-d absorption spectra of divalent lanthanides in alkali-halides hosts: II. $\text{CaCl}_2:\text{Ln}^{2+}$ (Ln = Sm, Eu, Tm, and Yb).

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Rok wydania

2018

Czasopismo

Journal of Luminescence

Numer woluminu

197

Strony

66-75

DOI

10.1016/j.jlumin.2018.01.011

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Streszczenie

Systems containing divalent lanthanide elements (Ln^{2+}) are hard to synthesize and thus their characterization is still largely an unexplored area. The absorption spectra of most divalent Ln^{2+} ions were, until recently, obtained nearly exclusively for $\text{Ln}^{2+}:\text{CaF}_2$ crystals. In the first paper in a series devoted to systematic analysis of f-d absorption spectra of Ln^{2+} in alkali-halides hosts we presented new experimental data for Nd^{2+} and Dy^{2+} ions in SrCl_2 and reanalyzed available data for $\text{SrCl}_2:\text{Ln}^{2+}$ (Ln = Sm, Eu, Tm, and Yb). The increased number of spectral data on the f-d transitions for Ln^{2+} ions makes SrCl_2 the second best studied matrix. The second paper in this series is devoted to $\text{CaCl}_2:\text{Ln}^{2+}$ (Ln = Sm, Eu, Tm, and Yb). The first absorption, emission, and excitation spectra for Sm^{2+} , Eu^{2+} and Yb^{2+} in CaCl_2 are reported. Using a uniform methodology based on a parametric Hamiltonian model proposed in Part I, a systematic analysis of the spectra is performed. This approach yields refined and consistent sets of the free-ion parameters and crystal-field (CF) ones. Systematic CF analysis of the large spectral dataset for $\text{CaCl}_2:\text{Ln}^{2+}$ consisting of a total of four ions allows revealing inherent trends across the Ln series. Our results enable partial verification of the trends uncovered in Part I for $\text{Ln}^{2+}:\text{SrF}_2$. It appears that the trends in the free-ion parameters and, to a lesser extent, CF ones observed for one Ln^{2+} ion are sufficiently systematic to allow for tentative predictions of the spectrum for any lanthanide ion based on the sets of parameters derived from the spectra obtained for another ion in the same matrix.

Słowa kluczowe

Rare earth alloys and compounds, Optical absorption spectroscopy, Ln 2+ :CaCl₂, Divalent Sm, Eu, Tm, and Yb, Crystal and ligand fields

Adres publiczny

<https://doi.org/10.1016/j.jlumin.2018.01.011>

Strona internetowa wydawcy

<http://www.elsevier.com>

Plik został wygenerowany dnia 2026-04-23 13:29:45

Adres w repozytorium <https://old.chem.uni.wroc.pl/pl/repozytorium/dcR0im6>.