Structural and spectroscopic characterizations of new Cd_{1-3x} Nd_{2x} $\square_x$ MoO_4 scheelite-type molybdates with vacancies as potential optical materials.

Autorzy

Małgorzata Guzik

Elżbieta Tomaszewicz

Yannick Guyot

Janina Legendziewicz

Georges Boulon

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Streszczenie

The necessity to develop new laser materials of tungstates and molybdates is our motivation to study a new family of molybdates activated by Nd^{3+} ions, which crystallizes in the scheelite-type structure (the tetragonal symmetry, the space group $I4_1/a$). A series of $Cd_{1-3x}Nd_{2x}?_xMoO_4$ stable solid solutions with concentration of Nd^{3+} ions from 0.1 mol% to 66.67 mol% with respect to Cd^{2+} ions were successfully synthesized by a high-temperature annealing, using $CdMoO_4$ and $Nd_2(MoO_4)_3$ as the starting materials. Structural and spectroscopic characterizations of Nd^{3+} substituting Cd^{2+} ions were carried out. The substitution of divalent Cd^{2+} by trivalent Nd^{3+} cations leads to the formation of cationic vacancies in the framework (which are denoted in the chemical formula as ?). The Nd^{3+} ions in this matrix occupy two non-equivalent symmetry sites depending on the location of these vacancies. Concentration of vacancies depends essentially on the composition of initial $CdMoO_4$–$Nd_2(MoO_4)_3$ mixtures. The SEM analysis of crystal morphology reveals high homogeneity of the nearly-spherical shaped products with an average grain size of about 1–10 μm. Optical analysis and the laser parameters suggest that $Cd_{1-3x}Nd_{2x}?_xMoO_4$ can be considered as a potential laser material. Both the values of the absorption cross-section and the strong emission of the $^4F_{3/2}$ › $^4I_{11/2}$ laser channel of Nd^{3+} recorded under LED source excitation or OPO laser pumping, as well as the radiative lifetimes of NIR luminescence, are appropriate for potential applications of this optical material as a solid state laser.

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