Spectroscopic properties, concentration quenching and Yb^{3+} site occupations in vacancied scheelite-type molybdates.

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A series of micro-crystalline Yb^{3+}-doped vacancied $Cd_{1-3x}Yb_{2x}\square_xMoO_4$ solid solutions has been prepared by a high-temperature solid state reaction method. The structural studies performed by X-ray powder diffraction measurements have shown that the samples are monophasic and crystallize in the tetragonal scheelite-type structure (the space group $I4_1/a$, with point symmetry close to D_{2d}) when the *x* parameter is greater than 0 and does not reach 0.1430 (33.36 mol% of Yb^{3+} ions). The substitution of divalent Cd^{2+} by trivalent Yb^{3+} cations leads to the formation of cationic vacancies in the framework (which are denoted in the chemical formula as □), due to the charge compensation: $3Cd^{2+} \rightarrow 2Yb^{3+} + \square$ vacancy. Direct excitation of Yb^{3+} by means of $^2F_{7/2} \rightarrow {}^2F_{5/2}$ absorption at 940–980 nm leads to reversed $^2F_{5/2} \rightarrow {}^2F_{7/2}$ transitions giving Yb^{3+} emission in the range of 970–1130 nm. The intense and broad emission lines of Yb^{3+} ions, which are also used as a structural probe at 77 K have been observed. The existence of more than one component of the 0-phonon line at 975 nm and 976.6 nm indicate two Yb^{3+} distribution sites, which is in agreement with results obtained for the Nd^{3+} ion. Basing on the absorption and emission spectra the Yb^{3+} electronic energy levels have been proposed. The effect of dopant concentration had an influence on luminescent properties but had no influence on the powder morphology. Yb^{3+}concentration dependences of the $^2F_{5/2}$ experimental decay time were analyzed in order to attempt the understanding of the concentration quenching mechanism and estimate the main parameters useful for a theoretical approach of laser potential.

Słowa kluczowe

Yb3+ dopant, Cadmium molybdate, Vacancied micro-powders, photoluminescence, Concentration quenching, Self-trapping