Functional Materials 7, No.3 (2000)

Luminescent properties of $CdWO_4$ crystals doped with Dy^{3+} ions

S.G.Nedil'ko, M.Diab, O.V.Chukova, V.I.Sheludko*

T. Shevchenko Kyiv National University, Physics Department,
6 Acad. Glushkov Ave., 03680, Kyiv, Ukraine
*Dept. of Science of AlBaas University, Homs, Syria

This paper reports about results of luminescence investigations of cadmium tungstate ($CdWO_4$) crystals doped with dysprosium ions (Dy^{3+}): $CdWO_4$–Dy^{3+} crystals. The absorption (excitation) spectra consist of lines that observed in the 16000–28000 cm^{-1} region on the nonstructural background formed by matrix absorption and caused by electron transitions in Dy^{3+} ions from the ground level $^6H_{15/2}$ to the excited levels $^4F_{9/2}$, $^4I_{15/2}$, $^4G_{11/2}$ and etc. Photoluminescence spectra of $CdWO_4$–Dy^{3+} crystals in 4.2–350 K temperature region consist of broad nonstructural bands of own $CdWO_4$ matrix emission and lines with the full width at half of maximum 1.0–10 cm^{-1} observed in three spectral regions: 475–490, 570–590, 650–675 nm, those are corresponded respectively to $^4F_{9/2} \rightarrow {}^6H_{11/2}$, $^4F_{9/2} \rightarrow {}^6H_{13/2}$, $^4F_{9/2} \rightarrow {}^6H_{15/2}$ transitions in Dy^{3+} ions. Analysis of the obtained number of lines as well as analysis of the dependence of parameters of observed lines on temperature and excitation energy allow us to do conclusion about existence of two types of Dy^{3+} luminescence centers that occupy various sites in $CdWO_4$ crystal matrix.

В статье приведены результаты люминесцентных исследований кристаллов вольфрамата кадмия ($CdWO_4$), легированных ионами диспрозия Dy^{3+}; $CdWO_4$–Dy^{3+}. Их спектры поглощения (возбуждения) состоят из линий, наблюдающихся в области 16000–28000 $см^{-1}$ на фоне бесструктурного поглощения матрицы и отвечают электронным переходам в ионах Dy^{3+} с основного уровня $^6H_{15/2}$ на возбужденые уровни $^4F_{9/2}$, $^4I_{15/2}$, $^4G_{11/2}$ и т.д. Спектры фотолюминесценции кристаллов $CdWO_4$–Dy^{3+} в области температур 4.2–350 К состоят из широкого бесструктурного фона собственного свечения матрицы $CdWO_4$ и линий с полушириной 1.0–10 $см^{-1}$, которые находятся в трех спектральных диапазонах: 475–490, 570–590, 650–675 нм, и относятся соответственно к переходам $^4F_{9/2} \rightarrow {}^6H_{11/2}$, $^4F_{9/2} \rightarrow {}^6H_{13/2}$, $^4F_{9/2} \rightarrow {}^6H_{15/2}$ в ионах Dy^{3+}. Анализ количества линий в спектрах поглощения и люминесценции вместе с анализом зависимости параметров наблюдаемых линий от температуры образцов и энергии возбуждения позволил сделать вывод об образовании двух типов центров люминесценции Dy^{3+}, отличающихся способом размещения ионов Dy^{3+} в кристаллической матрице $CdWO_4$.

Investigation of luminescence related with impurity ions situated in non isomorphic, in particular, non-isocharged sites of host matrix is of a great scientific interest. This is connected with that the features of both structure and electron-vibron interactions in such luminescence centers are defined not by the "ideal" matrix structure but by the nearest neighborhood of impurity which is formed so that it must compensate distortions generated by impurity.

The importance of such investigations increases when crystals capable of the proper, "self-activated" luminescence defined by structural defects of host crystal are taken as matrices. Cadmium tungstate CWO, crystals are such ones important from the practical point of view [1, 2].

In this work, investigation results of main spectral and luminescent characteristics are reported for CWO crystals doped with dysprosium ions Dy^{3+}: CWO–Dy^{3+}. The Dy^{3+} ions have the odd number of elec-