Functional Materials 15, No.2 (2008)

$ZnMgSe:Cr^{2+}$ single crystal: a novel material for active elements of tunable IR region lasers (rapid communication)

Yu.A.Zagoruiko, N.O.Kovalenko, O.A.Fedorenko, V.A.Khristyan

Institute for Single Crystals, STC "Institute for Single Crystals", National Academy of Sciences of Ukraine, 60 Lenin Ave., 61001 Kharkiv, Ukraine

Received April 20, 2008

Obtained is a new thermostable material for active elements of tunable IR-lasers – $Zn_{1-x}Mg_xSe:Cr^{2+}$, single crystals. The position of the absorption band of Cr^{2+} ions in wurtzite-type $Zn_{0.79}Mg_{0.21}Se$ matrix is established.

Получен новый термостабильный материал - монокристаллический $Zn_{1-x}Mg_xSe:Cr^{2+}$, для активных элементов перестраиваемых лазеров ИК-диапазона. Определено положение полосы оптического поглощения ионов Cr^{2+} в матрице $Zn_{0.79}Mg_{0.21}Se$ со структурой типа "вюртцит".

A great attention in the modern materials science is paid to development of a novel class of laser crystals intended for active elements of tunable lasers of intermediate IR region (2 to 5 μm). Such materials are obtained by doping the crystals of $A^{II}B^{VI}$ binary compounds and solid solutions thereof with Cr^{2+}, Fe^{2+} ions [1, 2]. Judging from comparative consideration of optical and electrophysical characteristics of those materials and generation characteristics of active elements on the basis thereof, it is just $ZnSe:Cr^2$ crystals that are today of the greatest practical interest. It is be to noted that there are no literature data concerning the application of ZnMgSe crystals doped with transition metals in the manufacturing of a laser material. The structure, mechanical, optical, and electrophysical properties of $Zn_{1-x}Mg_xSe$ single crystals ($0.03 \le x \le 0.55$) were studied comprehensively in [3]. Basing on the study results, hexagonal crystals of substitution solid solution $Zn_{1-x}Mg_xSe$ ($0.12 \le x \le 0.50$) have been proposed as a thermostable material for polarization and electrooptical elements of near and intermediate IR region [4].

In this work, further developing the studies [3, 4], presented are optical characteristics of $Zn_{1-x}Mg_xSe:Cr^{2+}$ single crystals ($x \approx 0.21$). The material was obtained by diffusion doping of $Zn_{1-x}Mg_xSe$ single crystals ($10 \times 10 \times 1$ mm^3 size) with chromium. The Cr

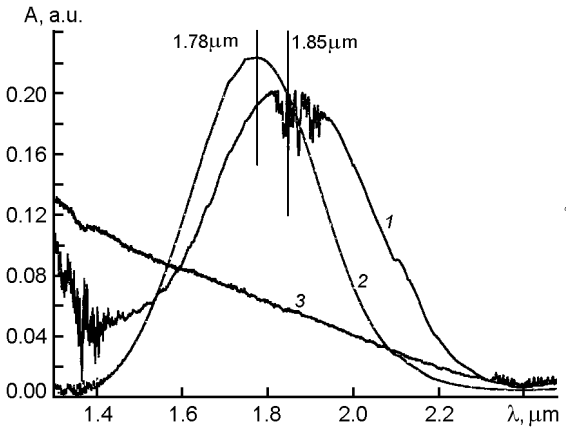

Fig. Absorption spectra of single crystals: $ZnMgSe:Cr^{2+}$ (*1*), $ZnSe:Cr^{2+}$ (*2*), ZnMgSe (*3*).

diffusion was realized from vapor phase in evacuated sealed quartz ampoules at 1250 K for 120 h. The optical transmission spectra of $ZnSe:Cr^{2+}$, $Zn_{1-x}Mg_xSe$ ($x \approx 0.21$) and $Zn_{1-x}Mg_xSe:Cr^{2+}$ ($x \sim 0.3$) samples were recorded using a Perkin Elmer Spectrum One FT-IR spectrometer. The Figure presents the optical absorption spectra for those samples calculated from the optical transmission ones taking into account the corresponding refractive indices. The optical transmission spectra of $ZnSe:Cr^{2+}$ and $Zn_{1-x}Mg_xSe$ ($x \approx 0.21$) samples are seen to contain strong absorption bands with maxima at 1.780 μm and 1.855 μm, respectively. The presence of such absorption bands testifies to the application possibility of $Zn_{1-x}Mg_xSe:Cr^{2+}$ single crystals as a novel thermostable material for active elements of tunable lasers of intermediate IR region having the generation band shifted towards the long-wavelength range with respect to that of $ZnSe:Cr^{2+}$.

References

1. H.Jelinkova, P.Koranda, M.E.Doroshenko et al., *Laser Phys. Lett.*, 1 (2006).
2. V.A.Akimov, A.A.Voronov, V.I.Kozlovsky, et al., *Quantum Electronics*, **34**, 879 (2004).
3. Yu.A.Zagoruiko, O.A.Fedorenko, N.O.Kovalenko et al., in: Proc. of SPIE, Materials and Electronics for High-Speed and Infrared Detectors, **3794**, 96 (1999).
4. Ukrainian Pat. 46429A (2001).

Монокристалічний $ZnMgSe:Cr^{2+}$ – новий матеріал для активних елементів лазерів ІЧ діапазону з перестроюванням частоти

Ю.А.Загоруйко, Н.О.Коваленко, О.О.Федоренко, В.А.Христьян

Отримано новий термостабільний матеріал для активних елементів ІЧ-лазерів з перестроюванням частоти – монокристалічний $Zn_{1-x}Mg_xSe:Cr^{2+}$. Визначено смугу поглинання іонів Cr^{2+} у матриці $Zn_{0.79}Mg_{0.21}Se$ зі структурою типу "вюртцит".