STUDY OF THE DEPENDENCE OF THE RADIATION INTENSITY IN THE NEAR INFRARED RANGE OF ZnSe:Cr WITH A CHANGE IN THE POWER OF THE EXCITING SOURCE OF THE Nd:YAG LASER FROM 1 mW TO 10 mW

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The aim of this work is to study the photoluminescence spectra of impurity defects in near infrared radiation for ZnSe:Cr^{+} crystals with a variable concentration of chromium atoms when changing the power of the excited light from 1 mW to 10 mW. The samples were excited by light with a wavelength of 532 nm (the second harmonic of the Nd:YAG laser), and in the luminescence spectrum, maxima were observed for all samples at a wavelength of 930 nm, but they differed in intensity and half-width.

Keywords: polycrystalline CVD (chemical vapor deposition) ZnSe, impurity-defect luminescence, chromium in zinc selenide, high isostatic pressure(HIP).
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INTRODUCTION

Numerous studies [1-6] IR lasers generating in the range of 1.9-3 μm on Cr^{2+} doped polycrystalline CVD ZnSe samples are promising for optics, optoelectronics, laser technology, etc. The radiative processes are mainly intracenter d-d transitions described by crystal field theory [1-3].

These studies mainly investigated the mid-infrared (IR) range, at low temperatures.

In this paper, we investigate the photoluminescence spectra in the wavelength range of 0.8–1.1 μm observed upon excitation by semiconductor lasers (λ_{ex} = 532 nm) in two CVD ZnSe samples doped with different iron concentrations at room temperature (T = 300 K). In particular, the dependence of the intensity of the maxima in the photoluminescence spectra on the excitation source power is considered.

METHODS AND EXPERIMENTS

Fe film was deposited on both sides of CVD ZnSe samples by electron beam evaporation, followed by diffusion doping by HIP (high isostatic pressure) processing

Diffusion doping in the first ZnSe: Cr31 sample was carried out at 1000 atm, 1423 K for 70h and in the second ZnSe: Cr32 sample at 1000 atm, 1423 K for 76 h.

The maximum iron impurity concentration determined from the absorption edge shift in the ZnSe:Cr samples is $6.1\cdot10^{19}$ cm^{-3} (ZnSe: Cr31) and $4.65\cdot10^{19}$ cm^{-3} (ZnSe: Cr32), respectively. The forbidden band widths are respectively 2.34eV and 2.4 eV .

The luminescence studies were carried out on a Nanofinder 30 Confocal micro-Raman spectrometer (Tokyo Instr., Japan). The second harmonic of the Nd:YAG laser with the radiation wavelength λex = 532 nm and the maximal power 10 mW was used as an excitation source. The spectral resolution was not worse than ~ 0.014 nm. A cooled CCD camera with the resolution 1024×128 pixels operating in photon-counting mode served as a radiation detector. the luminescence spectra were recorded in the region λ = 440÷1500 nm.

RESULTS AND DISCUSSION

The samples were excited by light with wavelength λex = 532 (at a power of 1 mW) and the luminescence spectrum of both samples shows maxima at 930 nm, but they differ in intensity and half-width.

The dependence of the intensity of the maximum in the spectrum on the excitation power was also investigated, with the excitation power varying from 1 mW to 10 mW. (Fig.1,2). As can be seen from the figures, the behavior of the intensity of the maxima on the excitation power is quite different. With an increase in the source power from 1 mW to 10 mW, the intensity of the maxima in the Cr 31 and Cr 32 samples also increases, but in the Cr31 sample, where the concentration of chromium atoms is higher, it is greater. Changes in the spectral position of the maxima in the Cr31 sample are not so noticeable, compared to the Cr32 sample, where it changes in the range of 930 nm-936 nm. The half-width of the maxima in the Cr31 sample decreases compared to Cr32.

It can be said that the mechanism of radiative recombination, which forms emission lines in the spectral range of 0.8-1.1 μm, is associated with intracenter radiative transitions of iron atoms included in the complex defect in the form of Fe^{2+}, i.e. it is associated with the radiative transition $^{3}T_1 - {}^{5}T_2$ [6-8].

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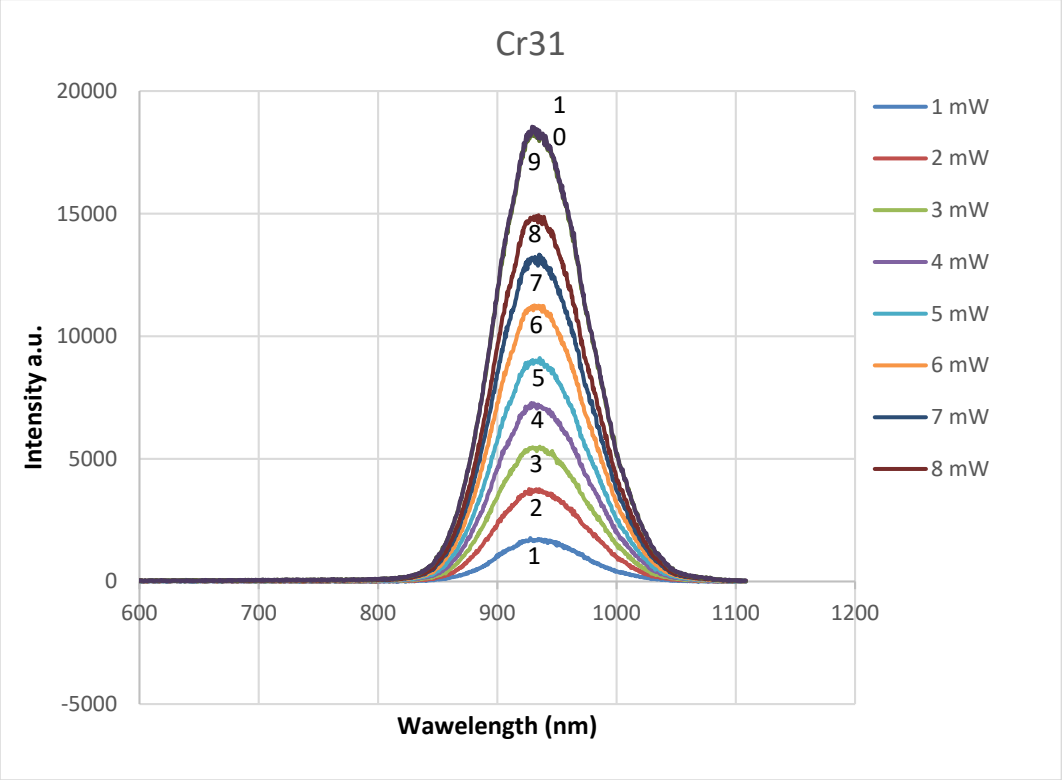

Fig.1. Dependence of radiation intensity corresponding to λ_{max} = 930 nm on the power of excitation source (laser at λex = 532 nm, sample ZnSe:Cr31).

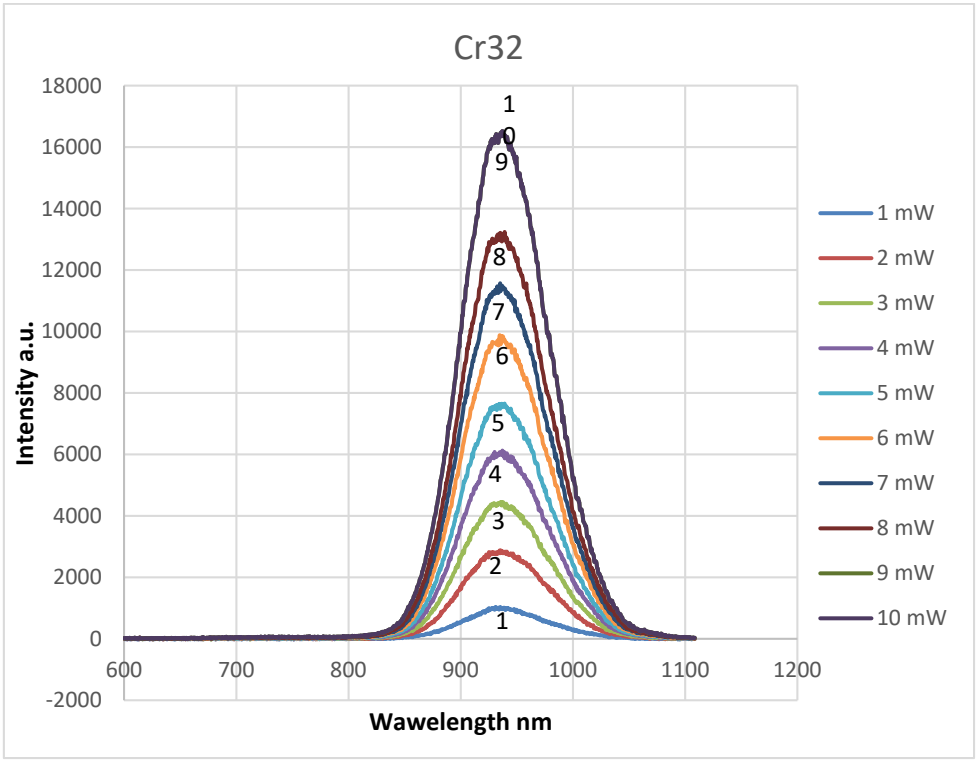

Fig.2. Dependence of radiation intensity corresponding to λ_{max} = 930 nm on the power of excitation source (laser at λex = 532 nm, sample ZnSe:Cr32).

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