

SPECIFIC FEATURES OF PHOTOLUMINESCENCE THERMAL QUENCHING IN HEXAGONAL BORON NITRIDE MICROPOWDER

Henaish A.M.A.^{1,2*}, Vokhmintsev, A.S.¹, Weinstein, I.A.¹, Kartashov V.V.¹

¹) Ural Federal University, NANOTECH Center, Yekaterinburg, Russia

²) Tanta University, Physics Department, Tanta, Egypt

*E-mail: ph_atomic@yahoo.com

Analysis of the experimental data of PL thermal quenching in frame of the Mott-Seitz formalism was carried out. It was shown that intensity decrease in temperature range RT – 800 K was characterized by two non-radiative relaxation channels. Values of corresponding activation energies were estimated.

Hexagonal boron nitride (h-BN) with forbidden gap about 5.5 eV is considered to be prospective material for various applications in micro-, optoelectronics and solid state dosimetry [1]. Currently, there are different methods for synthesizing h-BN powders with various grain size and shape. Understanding the mechanisms of luminescence and the origin of recombination and capturing centers is the key factor in development of emitting matrixes or detector arrays based on this material for use in high temperature conditions. The goal of the present research was to investigate the processes of photoluminescence (PL) quenching in h-BN powder in RT – 800 K temperature range.

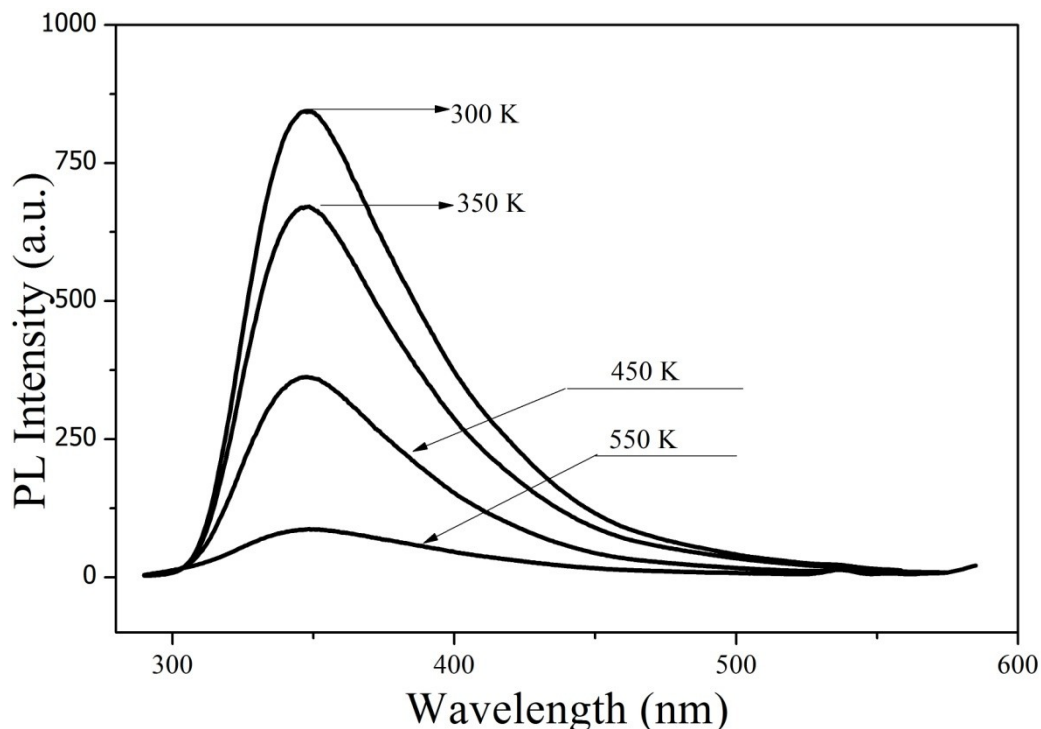


Fig. 1. Photoluminescence emission at different temperatures

In this work h-BN micropowder synthesized using plasma-chemical vapor deposition technique was studied. PL measurements were performed with using the Perkin Elmer LS55 spectrometer with developed high-temperature module [2]. Measure-

ments of emission spectra were carried out in 300 – 600 nm range under excitation in 225 nm wavelength. The PL thermal quenching in 345, 390 nm bands were measured in the heating and cooling modes at rate of $\beta = 1$ K/s in RT – 800 K temperature range.

It is shown that PL emission spectra have maximum at 350 nm band and PL intensity decreases with increasing temperature without changing the peak position, see Fig.1. It is demonstrated that PL spectra can be decomposed into three Gaussian components with $E_{\max} = 3.61, 3.28, 2.62$ eV and FWHM = 0.42, 0.70, 0.62 eV, respectively.

Semi-quantitative analysis of the experimental dependences of PL quenching was carried out within the Mott-Seitz formalism. It is shown that intensity decreasing in the investigated temperature range is characterized by two non-radiative relaxation channels with activation energies of $E_A = 0.27, 0.81$ and $0.22, 0.58$ eV in 345 and 390 nm bands, respectively. The possible mechanisms for observed quenching processes were discussed in frame of model representations of the oxygen-related complexes in different charged states.

1. Weinstein I.A., Vokhmintsev A.S., Minin M.G., Kartashov V.V., Chernetsky I.V., Radiation Measurements, 56, 236 (2013).
2. Vokhmintsev, A.S., Minin, M.G., Henaish, A.M.A., Weinstein, I.A., Measurement: Journal of the International Measurement Confederation 66, 90 (2015).

EFFECT OF IRON SUBSTITUTION BY COBALT ON THE CRYSTAL STRUCTURE AND PHASE TRANSITION OF $\text{Fe}_{7-y}\text{Co}_y\text{X}_8$ (X = S, Se) COMPOUNDS

Ibrahim P.N.G.^{1*}, Selezneva N.V.¹, Kazantsev V.A.², Baranov N.V.^{1,2}

¹) Institute of Natural Sciences, Ural Federal University, Ekaterinburg, Russia

²) Institute of Metal Physics, RAS, Ekaterinburg, Russia

*E-mail: peteribrahim@yandex.ru

Iron sulfide Fe_7S_8 and iron selenide Fe_7Se_8 have NiAs-type layered superstructures with the ordering of vacancies in each second metallic layer. When the temperature increases, these compounds show first-order structural transitions from superstructures with ordered vacancies to the NiAs-type structure with vacancy disorder at the critical temperatures $T_t \approx 590$ K [1] and $T_t \approx 660$ K for Fe_7S_8 and Fe_7Se_8 , respectively. The present work is aimed to study the effect of the Co for Fe substitution on the crystal structure and phase transitions in $\text{Fe}_{7-y}\text{Co}_y\text{X}_8$ (X = S, Se) compounds.

The polycrystalline samples $\text{Fe}_{7-y}\text{Co}_y\text{X}_8$ with cobalt concentration ranging from $y = 0$ to $y = 7$ were synthesized by solid-state reactions in evacuated quartz ampoules. All substituted samples $\text{Fe}_{7-y}\text{Co}_y\text{X}_8$ were found to have a layered 3C-type superstructure of the NiAs-type. It was found that, the average interlayer distance characterized