KAUNO
TECHNOLOGIJOS
UNIVERSITETAS

ISSN 1822-508X

International Conference

RADIATION INTERACTION WITH MATERIAL AND ITS USE IN TECHNOLOGIES 2008

Kaunas, Lithuania
24-27 September, 2008

ISSN 1822-508X

KAUNAS UNIVERSITY OF TECHNOLOGY
VYTAUTAS MAGNUS UNIVERSITY
LITHUANIAN ENERGY INSTITUTE
RIGA TECHNICAL UNIVERSITY

International Conference

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Program and materials

TECHNOLOGIJA
KAUNAS, 2008

P1-6

PHOTOLUMINESCENCE OF ZnO NANOSTRUCTURE FORMED BY LASER RADIATION

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Abstract

The possibility of formation of ZnO nanostructures in polyvinylalcohol matrix by powerful laser radiation is studied in this work.

Key words: *ZnO, nanostructures, laser radiation, photoluminescence*

ZnO has attracted quite much attention due to different applications. The large exciton (Ex) binding energy (60 meV) [1] allows to observe exciton emission even at room temperature. At room temperature, the band gap energy of ZnO is around 3.37 eV (wavelength λ= 368 nm) [2].

The aim of this work is to study the possibility of formation of ZnO nanostructures in polyvinylalcohol (PVA) matrix by powerful laser radiation.

Experiments were carried out on ZnO particles embedded in polymer PVA matrix. PVA powder was dissolved in distilled water under magnetic stirring to form a transparent solution. Prepared ZnO nanoparticles were added to the PVA solution followed by a mixing process to produce a homogeneous mixture. Then, PVA/ZnO solution was sonificated to deagregate ZnO particles and to distribute homogeneously nanoparticles in PVA matrixes. PVA/ZnO nanocomposites were prepared by solution mixing, followed by film casting, and their physical properties were investigated. The films were obtained by slow evaporation in dry air.

A Nd:YAG laser with following parameters: power P=1MW, wavelength λ=532nm and pulse duration τ=10ns, was used for irradiation of the samples. Photoluminescence (PL) and scanning electron microscope (SEM) were used for study of the irradiated samples. PL spectra for no irradiated and irradiated samples with different laser intensities are measured at room temperature (RT) and 13K and results are shown in Fig.1.We can see that PL spectrum at RT consists of two bands one is ascribed to excitonic (1LO_Ex) with maximum around 3.26 eV and the second one at about 2.2-2.5 eV is due to defect states. At 13K the wide band peaking at 3.326 eV is detected and is due to superposition of Ex-D^0 and 1LO-Ex states in ZnO [3]. The ratio of defect band intensity to

excitonic band intensity increases with intensity of laser radiation. Therefore, the laser radiation generates intrinsic defects. SEM study was shown formation of pores after irradiation by the laser at intensity more than I= 30 MW/cm^2.

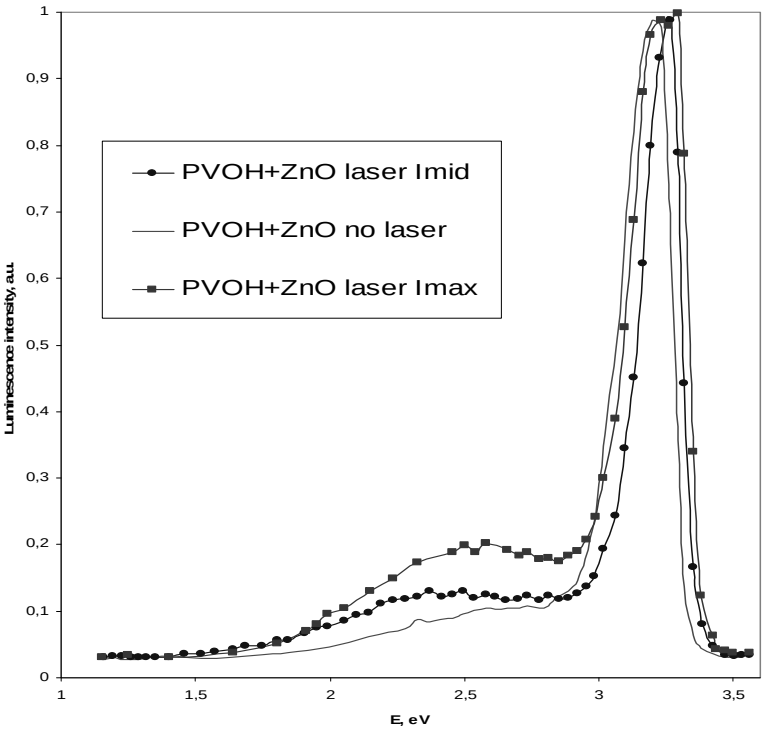

Fig.1 PL spectra of the no irradiated and irradiated PVA/ZnO sample at the laser intensity I_{max} =50.0MW/cm^2 and I_{mid}=36.0 MW/cm^2.

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