CdZnTe RADIATION HARDNESS INCREASING BY LASER RADIATION

Artur Medvid'[1,2], Aleksandr Mychko[1], Edvins Dauksta[1], Ernesto Dieguez[3], Yuriy Naseka[2]

[1]*Institute of Technical Physics, Riga Technical University,*
[2]*Institute of Semiconductor Physics, Kyiv, Ukraine*
[3] *University of Madrid, Spain*
14/24 Azenes Str. LV-1048,Riga, Latvia, mychko@latnet.lv

Abstract

Radiation damage occurred in semiconductors devices during their operation and it impairs the ability of equipment. The work deals with study of possibility to increase the radiation hardness of CdZnTe crystal using laser radiation.

Key words: *CdZnTe, radiation hardness, Nd:YAG laser.*

Experiment and discussion

As a source of light, Nd:YAG laser with following parameters: wavelength λ=0.532 μm, pulse duration τ=10 ns, intensity range I=0.48-1.8 MW/cm^2 was used. The method of photoluminescence (PL) was used for estimation of crystalline lattice damage after irradiation by gamma ray. $Cd_{0.9}Zn_{0.1}Te$ crystal was used as an object of investigation. It is known that γ-radiation is mainly caused intrinsic defect generation in a semiconductor. The effect consists in increasing of A^0X band in PL spectrum of CdZnTe by nine times after γ-irradiation by ^{60}Co source (E_γ = 1.2 MeV) at room temperature with dose of $5x10^5$ Rad = 5 KGy as shown a fig.1. Experimental results showed that this effect is suppressed by five times in CdZnTe crystal after preliminary irradiation by the laser at intensity 1.8 MW/cm^2 (Fig.1). The decrease of A^0X band intensity in PL spectrum indicates the decrease of Cd vacancies concentration in CdZnTe. The mechanism of this effect is explained in the following way: γ radiation leads to generation of additional Cd vacancies near the surface layer, which causes an increase of A^0X band intensity in PL spectrum. Laser radiation has an opposite effect on $Cd_{0.9}Zn_{0.1}Te$ crystal, interstitial Cd atoms are concentrated near the irradiated surface layer, but vacancies in the bulk of semiconductor [1]. This leads to A^0X band intensity decrease and increase of D^0X band in PL spectrum [2]. Cd atoms concentration incensement near the surface layer leads to increase of materials radiation hardness, because Cd atomic weight is larger comparing to other atoms - Zn and Te.

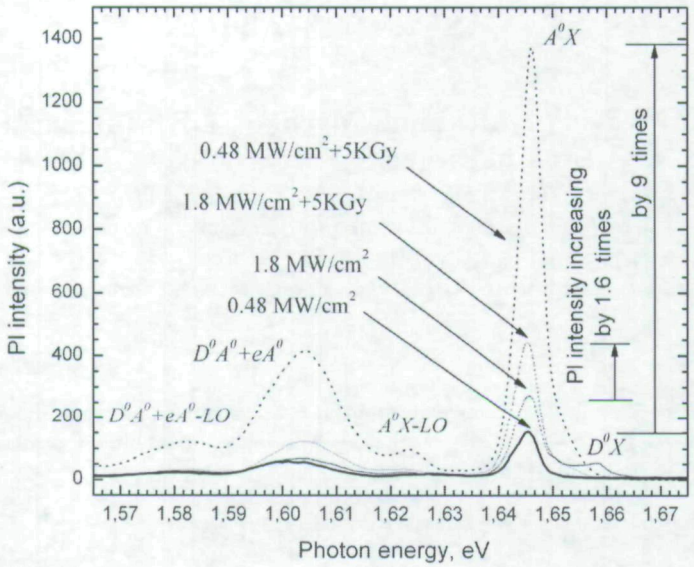

Fig.1. Photoluminescence spectra of CdZnTe crystal preliminary irradiated by laser with intensity 0.48 MW/cm^2 and 1.8 MW/cm^2 and subsequently irradiated by γ rays with dose of 5 KGy.

Conclusion

CdZnTe radiation hardness increasing by heavily absorbs Nd:YAG laser radiation was shown. The radiation hardness increasing for gamma radiation was connected with Zn concentration decreasing on the semiconductors surface. The mechanism of radiation hardness increasing was explained by thermogradient effect.

References

1. A.Medvid' *Defects and Diffusion Forum*, 2002, 89, 210-212p.

2. A. Medvid', L. Fedorenko, A. Mychko, *Radiation Measurements*, 2007, 42, 701 – 703.