International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

IJIEMR Transactions, online available on 30th May 2022.
Link: https://ijiemr.org/downloads/Volume-11/Issue-05

DOI: 10.48047/IJIEMR/V11/I05/35

Title: **CHANGES OF ACCEPTOR SETS IN N-INP UNDER THE EFFECT OF GAMMA QUANTUM**

Volume 11, Issue 05, Pages 208-213

Paper Authors: **Odil Raximov**

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

CHANGES OF ACCEPTOR SETS IN N-INP UNDER THE EFFECT OF GAMMA QUANTUM

Odil Raximov
Associate Professor at the Samarkand State Architectural and Civil Engineering Institute
Email: zafar_r80@mail.ru

ABSTRACT: The study found that the set of acceptors in n-InP: cd changes under the influence of point-specific defects formed by the action of gamma quantum. The function N_z (z) of the concentration of N_z of acceptor complexes as a function of the number of Z accelerators included in them is found..

Keywords: N_D donors and N_A acceptors, point-specific defects, effective cut, drift, electrically active centers, complex.

INTRODUCTION

In recent years, the study of the distribution of atoms across the crystal size of atoms and their interactions with radioactive defects has attracted the attention of many because of its importance in the creation of semiconductor devices.

Semiconductor materials are used in the power supply, heating and cooling systems of modern buildings. However, under the influence of α, β, γ - radiation from space, semiconductor materials have to take into account the properties of maintaining or changing their electrical conductivity.

Defects in the structure of indium phosphide are less studied than in other semiconductors. Point defects in InP occur in the form of compounds of special-point defects or compounds of atoms mixed with special-point defects, and these compounds are stable at a temperature of 100-300 K. Private-point defects generated by gamma light or an electron with an energy of 1 MeV are motile at 77 K. [1]

Unalloyed, chemically pure, InP contains ~ 8 $10^{15}sm^{-3}$ hydrogen atom-like atoms and the concentration of acceptors does not exceed ~ 8 $10^{15}sm^{-3}$ [2]. Copper, zinc, cadmium and other acceptor compounds are used to obtain a material with a lower electron concentration. Some of the acceptor compounds are homogeneously distributed throughout the crystal volume, and some may form complexes. Such complexes are surrounded by a space charge field. This field strongly influences the electrical parameters of the material and makes it non-homogeneous [3]. Spatial charge fields have a strong effect on the photoelectric properties of a semiconductor. The study of this property is one of the ways to study the complexes of acceptors and electrically active centers (EAMs).

The concentration of the complexes and the number of EAMs included in them can be determined by measuring the kinetics of the decrease in transmittance [4-8].

Main part

The aim of the study was to investigate the kinetics of the rate of change of specific-point defects in n-InP: cd material under the influence of gamma quantum and the change in the complexes of acceptor atoms.

n-InP: cd material was obtained by Chokhralsky's method of cultivation. Gamma

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

quantum irradiation was performed on a ^{60}Co device at room temperature.

The Hall coefficient, the temperature dependence of the electrical conductivity, was measured in the range of 4.2–300 K, and the kinetics of the decrease in photoconductivity were measured at 77 K at different doses of the gamma quantum (Table 1).

Table 2 shows the effective cross-sectional values of the formation of donors and acceptors in n-InP materials σ_D, σ_A

Table 3 shows the increase in the number of N_M acceptor complexes of n-InP in γ-radiation and the value of the volume f occupied by this complex.

Analyzing the results, we solved the equation of continuity of charge carriers and calculated the concentration, mobility of electrons and the concentrations of N_A acceptors, N_D donors.

In n-InP: cd, the dependence of N_A and N_D concentrations on the gamma quantum dose, i.e., the linear increase with increasing dose, is shown in Figure 1. The difference between the rates of change of N_A and N_D can be explained by the mobility of special-point defects and the formation of compounds with the atoms of the compound.

Considering the effect of gamma light on the size of acceptor complexes, the dependence of the concentration of N_Z of acceptor complexes $N_Z(Z)$ on the number of Z acceptors entering them in n-InP: cd material is shown in Figure 2 for non-irradiated and g-irradiated cases. shown. The $N_Z(Z)$ function varies (increases) depending on the gamma quantum dose.

In non-irradiated n-InP: cd, the number of acceptors in the largest complexes is Z = 30 and their concentration is ~ ~10^{10}sm^{-3}. As the gamma light dose increased, the number of acceptors in the large complexes reached a concentration of ~10^{11}sm^{-3} with Z = 40 (Figures 2, Figures 1 and 2).

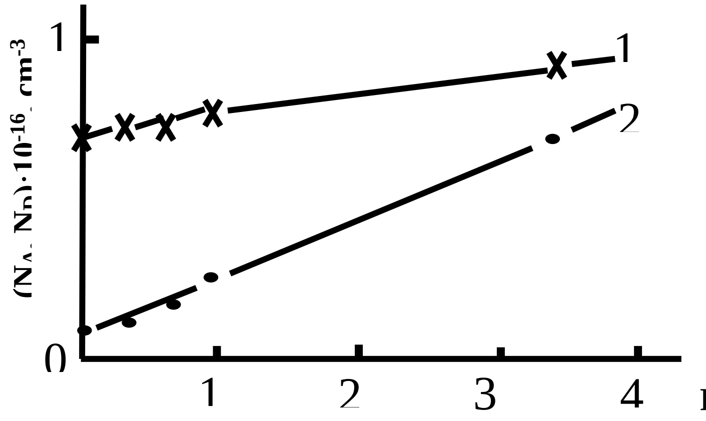
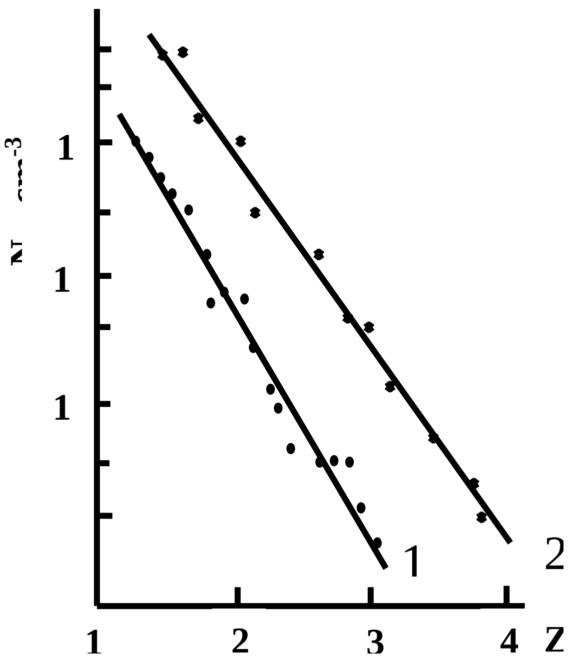


Figure 1. Concentrations of N_A acceptors and N_D donors for n-InP depend on gamma quantum dose.
1 - N_A acceptors, 2 - N_D donors



International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Figure 2. n-InP: $N_Z(Z)$) function of the concentration of N_Z of receptor complexes in cd depends on the number of Z acceptors entering them

1 – F =0

2 – $5,2\cdot10^{18}$ cm^{-2}.

It is not possible to find small acceptor complexes (Z <10) by measuring the residual photoconductivity because the size of the complexes is smaller than the free path of the current-carrying electrons.

Small complexes act as effective scattering centers for electrons.

Table 1. The main paramers of phosphide indium

Alloyed	$F\cdot10^{19}sm^{-2}$	$n\cdot10^{-15}sm^3$	$n_1\cdot10^{-15}sm^3$	$n^{4,2K}=n_2\cdot10^{-15}sm^3$	$R\sigma$, $cm^2/V\cdot s$		$R\sigma^{4,2K}=U_2$ $cm^2/V\cdot s$	σ, $om^{-1}\cdot sm^{-1}$		
		300K	78K		300K	78K		300K	78K	4,2K
Cd	0	6,07	3,88	5,2	4510	10500	125	4,4	7,02	0,104
	0,59	5,68	3,57	4,64	4500	10020	100	4,1	6,24	$7,6\cdot10^{-2}$
	1,47	4,81	2,87	3,86	4470	9480	71	3,4	4,76	$4,37\cdot10^{-2}$
	2,90	3,9	2,01	3,21	4380	8940	32	2,7	3,14	$2,63\cdot10^{-2}$
	3,49	3,38	1,53	2,0	4090	8660	23	2,2	2,3	$7,08\cdot10^{-3}$
	3,85	3,2	1,42	1,83	3840	8470	15	2,0	2,13	$4,4\cdot10^{-3}$
	4,08	2,93	1,36	1,6	3740	8240	11	1,7	1,95	$2,82\cdot10^{-3}$
	4,62	2,6	1,15	-	3600	7700	-	1,5	1,51	$1,23\cdot10^{-3}$
	5,07	2,47	1,03	-	3570	7210	-	1,4	1,28	$4,79\cdot10^{-4}$
Zn	0	1,36	0,91	-	2650	7600	-	0,79	1,26	-
	0,86	0,60	0,22	-	2070	1062	-	0,2	0,38	-
Cu	0	2,5	1,5	-	2450	5600	-	0	1,34	-
	0,59	1,5	1,0	-	1640	2440	-	0,4	0,53	-

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

2-table.

n-InP effective cuts to form donors and acceptors in the material σ_D and σ_A.

Legirlangan	$\sigma_D \cdot 10^{-26}$ sm^{-2}	$\sigma_A \cdot 10^{-26}$ sm^{-2}
Legirlanmagan	0,4	1,0
Cd	0,33	0,66
Cu	1,3	1,3
Zn	3,1	3,1

Figure 3.

n-InP material N_m an increase in the number of acceptor complexes under the influence of radiation (γ)

Alloyed	f, % F=0	$N_M \cdot A^{*)}$,sm^{-1} F =0
Not alloyed	1	$3 \cdot 10^3$
Cd	1	$3 \cdot 10^3$
Cu	34	$1,1 \cdot 10^5$
Zn	36	$1,2 \cdot 10^5$

*Evaluation was performed (performed) at a temperature of T = 300 K, using the method [6].

Conclusion. In summary, the size of large (Z> 10) acceptor complexes increases with increasing gamma light dose and the barrier-insulator size increases.

and acts as a barrier, so electrons are forced to bypass the insulators**.**

1. In the n-InP: cd material, it was found that the rates of formation of N_A acceptors and N_D donors under gamma quantum action were different.

2. If the n-InP: cd material contains acceptor complexes, an increase in the number of acceptors in the complexes was found to be due to the gamma quantum effect.

The nature of the increase in the size of acceptor complexes under the influence of gamma quantum is not yet known, but there are two possible assumptions:

a) if the original (non-irradiated) material contains a small number of acceptor complexes, the shielding length of the charges increases due to the decrease in the concentration difference between the donor ND and the acceptor NA formed in the radiation, and the radius of the spatial charge field increases accordingly;

b) Special point defects formed in the crystal structure are attracted by complexes by diffusion or drift.

References :

1. Врайловский Е.Ю., Кярапетян Ф.К. Тартанчик В.П. Отжиг точечных рядиационных дефектов в n-InP . -ФТП, 1979,т.13, в.10, с.2044-2046.
2. Кавалевская Г.Г., Попов Ю.Г., Слукаев Н.В. Электрические свойстве n-InP при низких температурах. -ФТП, 1967, т.1, в.2, с.225-229.
3. Дахно А.Н., Емельяненко О.В., Лагунова Т.С, Старосельцева С.П. Особенности переноса электронов в компенсированных кристаллах n-InP. -ФТП, 1979, т. 13, в.10, с.1988-1994.
4. Витовский Н.А., Лагунова Т,С. Однородный компенсированный фосфид индия с низкой концентрацией

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

електронов. - ФТП. 1981, т.15, с. 1034-1036.
5. Витовский Н.А. Метод определения заряда квазиточечных скоплений атомов примесей и дефектов в полупроводниках и функции распределения скоплений по их заряду. - ФТП. I982, т.16, в.5, с.832-385.
6. Витовский Н.А., Емельяненко О.В., Лагунова Т,С., Рахимов О. Определение заряда квазиточечных скоплений атомов акцепторний примеси в компенсированных кристаллах n-InP. – ФТП. 1982, т.16, в.6, с. 1122-1124
7. Баграев Н.Т., Витовский Н.А., Власепко Л.С, Машовец Т.В., Рахимов О. Скопления электрически активных центров в термообработанном кремнии, выращенном по методу Чохральского.- ФТП, 1983, т.17, в.11, с.I979-l984.
8. Rakhimov, Z. O., Haitboev, R., Ibadullaev, N. E., & Safarov, B. S. (2018). Tour operating. Study guide. Tashkent:“Science and Technology.
9. Raximov O., Eshbekov A.A. n-InP:cd materialida akseptop tuzilmalarining gamma kvanti hosil qiladigan hususiy-nuqtaviy nuqsonlar bilan ta’sirini o‘rganish. – Яримўтказгичлар физикасининг ҳозирги замон муаммолари. Республика илмий анжумани материаллари. 26-27 октябрь 2018 йил. 234-236 b.Тошкент.