International Journal of
Inclusive and Sustainable Education
ISSN: 2833-5414
Volume 1 | No 6 | Dec-2022

Properties of Mixed Atoms in Binary Semiconductors

Turaev Ergash Yuldoshevich [1], Eshmukhammadova Gulsunoi Khurram kizz [2]

[1] Professor of Termiz State University

[2] 2nd year master of Termiz State University

Abstract: The state of impurity atoms introduced into semiconductor materials determines the type of conductivity and the leaching of impurity atoms in the surface layer or inside the material was analyzed using the nuclear gamma resonance method.

Keywords: energetic state, resonance, gamma, semiconductor, compound, atoms, surface, spectroscopy, performances, isotope, isomer shift.

Introduction

Due to the fact that binary semiconductors are widely used in the production of such semiconductors, the study of their physical properties, structure, and states of mixed atoms included in them, as well as the influence of mixed atoms on the properties of semiconductor materials, is a topical issue.

Atoms of the elements introduced as mixed atoms can replace atoms in the structure of the semiconductor or can settle in the interatomic state, so they can dramatically change the properties of the semiconductor depending on their mixing. Therefore, the study of the properties of the mixed atoms introduced into semiconductors using electrophysical and spectroscopic methods is an interesting field of research. and many results have been obtained in this field [1,2].

In particular, impurity iron atoms incorporated into the most widely studied and widely used semiconductor material, *GaAs*, form two deeply located energy levels in the bandgap of this semiconductor at E_v+0.37$_{эв}$. But so far it is not clear whether these energy levels correspond to the isolated state of the atoms of the mixture or belong to the complex in the form of "mixed-mixed". It has also been determined that the distribution of mixed iron atoms in the semiconductor *GaAs* is characterized by its individual states on two surfaces and in the volume of the material [3]. The complex distribution of atoms of such a mixture is evaluated by the fact that the mixture is in a different state on the surface and volume of the material.

In the bulk of the semiconductor *GaAs*, Fe iron atoms have a cubic state, which can be considered as an isolated state [4]. Also, the energy levels generated in the bandgap of *GaAs* can be considered as belonging to isolated atoms. The Fe atoms located on the surface of the semiconductor *GaAs* form a complex with the surrounding vacancies, and for them there must be separate levels in the forbidden zone!

A process of charge change occurs for Fe atoms that settle on the surface and volume of the semiconductor *GaAs*, and this process depends on the state of the Fermi level.

As it is known that the parameters of YGR spectra in the nuclear gamma resonance spectroscopy method depend on the distribution symmetry and electronic structure of mixed atoms in semiconductor crystals, it can be considered that using this spectroscopic method to study the state of Fe atoms in *GaAs* will have certain significance. The application of the emission variant of nuclear

gamma resonance spectroscopy allows to obtain information about the surface part of the material and the impurity Fe atoms in the volume [5].

Methodology of experiments

P=1.6·10^{18}см$^{-3}$ based on the addition of P- and П- type zinc mixture of *GaAs* as starting material and П=1.6·10^{18}см$^{-3}$) semiconductor with tellurium mixture was used.

GaAs ярим ўтказгичига киритилган аралашма Fe атомларининг аралашиш коэффициенти унча юқори бўлмаганлиги (~10^{17}ат · см$^{-3}$, T=1050^{0}*C* да) сабабли ядровий гамма резонанс спектроскопияси спектрларини олиш учун ушбу методнинг эмиссион вариантидан фойдаланилди. Ўрганилаётган *GaAs* га *Co*^{57} изатопи киритилди, чунки емирилиш реакцияси туфайли Fe^{57} энергетик сатҳи хосил бўлади. Шу сабабли *Co*^{57} изотопининг зарядли холатини ўрганиш асосида аралашма Fe атомлари хақида маълумотга эга бўлиши мумкин бўдади.

The emission variant of this method was used to obtain nuclear gamma resonance spectroscopy spectra due to the fact that the mixing coefficient of impurity Fe atoms introduced into *GaAs* semiconductor is not very high (~10^{17}ат · см$^{-3}$, T=1050^{0}*C*).

The *Co*^{57} isotope was introduced into the studied *GaAs*, because the Fe^{57} energy level is formed due to the decay reaction. Therefore, based on the study of the charge state of the *Co*^{57} isotope, it is possible to obtain information about the Fe atoms of the mixture.

The results obtained.

In our experiment, it was found that the YaGRS spectra obtained in the surface layer for *Co*^{57}(Fe^{57}) atoms, in which the isotope of *Co*^{57} was electrolytically incorporated into *GaAs*, depend on the conductivity type of the semiconductor. The YGRS spectrum for impurity atoms on the surface of П type materials consists of a singlet (one) broadened line, while for P-type it consists of a П-quadrupole doublet.

The results of the experiment are given in the table below:

Material types	*Material size Fe*		*Fe atom on the surface*	
	δ	*ΔE*	*δ*	*ΔE*
П=1.6·1018см-3	*0,632*	*0,10*	*0,602*	*0,15*
P=1.6·10^{18}см$^{-3}$	*0,381*	*0,10*	*0,445*	*0,91*

150 mk from the semiconductor *GaAs* surface. The YaGRS spectra obtained after removing the thick layer changed. Although the spectra consisted of a singlet (one) line for both П- and P -type semiconductors, their isomer shifts were found to be different.

Conclusions

Based on the obtained results, the atoms of the iron mixture in the volume of the semiconductor *GaAs* are in a cubic structure, and they can be considered as isolated atoms, and the energy levels formed in the forbidden zone can be attributed to these iron atoms. In the surface layer, iron atoms combine with vacancies in the structure to form a complex, and this complex also creates energy levels. Such energy levels have been proven to be relevant for iron atoms in the surface layer of *GaAs* by the IR spectroscopy method [5]. It was found that the charge changes for iron atoms in the *GaAs* bulk and iron atoms in the surface layer depend on the position of the Fermi level. Changes in isomer shift values of YaGRS spectra also occur due to charge changes. This is due to a change in the electron density in the Fe^{57} core and a change in the charge distribution in the 3d shell.

References.

1. Тураев Э.Ю и другие. “Природа электрической неактивности примесных атомов в системе галлий -теллур”, Журнал “Физика и химия стекла”, 1987, т.13, стр.696-700.
2. Тураев Э.Ю., Серегин П.П. “Иследование методом мессбауэра влияния перехода кристалл – стекло на структуры полупровников” Письмо в ЖЭТФ №2, 1974, стр.81-82.

3. Turaev E.Yu.,Khalilova M.D., “The effect laser radiation on the productivity of then fiber cotton “, “International Buletin of engeneering and technology”., 2022,pp.134-136.
4. Тураев Э.Ю. и другие “Исследования состояния примесных атомов в полупроводниках” . журнал “Неорганические материалы”, 1991, т.27, стр.899-903.
5. Тураев Э.Ю. Серегин П.П. “Природа состояния, образуемых атомами олова и железа в модифицированном селениде мыщьяка”, Узбекский физический журнал, 1991, вып.58, стр.81-85.