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Review Article

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Influence Radiation Scale Photovoltaic Parameters of Double Barrier Structure on the Basis of Silicon

Abasov FP

Institute of Radiation Problems, Ministry of Science and Education Azerbaijan r. AZ 1143, Baku, B. Vahabzade Str. 9, Azerbaijan

Corresponding author
Abasov FP, Institute of Radiation Problems, Ministry of Science and Education Azerbaijan r. AZ 1143, Baku, B. Vahabzade Str. 9. Azerbaijan.

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ABSTRACT
This work analyzes the possibility of using the developed silicon-based double-barrier structures with increased integral sensitivity in the short-wavelength region. The influence of the radiation scale on the current mechanism has been studied both in a structure such as a Schottky barrier and in p-n junctions.

Keywords: Silicon Double -Barriers Structures, Barriers Schottky, P-N- Junctions, Photo Converters

Introduction

Silicon photo detectors, still the most widespread type of photo converters. One of the main directions of increase of speed and increase in spectral sensitivity of modern receivers of radiation with one transition is creation of multi barrier structures. In which thanks to internal strengthening and growth of coefficient of collecting of the photo generated carriers - it is possible to improve significantly key parameters which meet the requirements and needs of optoelectronics. Reliability of work of the received structures under the raised conditions of radiation, as detectors of ionizing radiation is an actual task and makes a subject of our researches.

Recently for expansion of area of spectral sensitivity methods [1,2] bringing to photocurrent growth in short-wave area of a range are widely used. Example can is - varizon band structures; pulling fields, etc., based on reduction of speed of a superficial recombination. In our case such opportunity, but in planar execution it is possible to create at the expense of a field r-p-transition included in the opposite direction.

Technique of Experiment and Discussion of Results

Features of two-barrier structures created on one plane are for the first time received and studied. It is shown advantages before traditional structures. For creation of photodetectors of planar execution with internal strengthening Au-Si Schottky barrier is created. As an initial material the structure p - n - type on a silicon substrate is used. The realization of management by current by means of light was enabled by selection of supply voltage of K-E in such a way that collector transition is closed, and emitter - is open, at free base. Under the influence of light in it electrons and holes are generated. At collector transition there is a division electronic hole couples which have reached owing diffusions of border transition. Holes are thrown by a field of transition to a collector, increasing own current, and electrons remain in base, lowering its potential. Thus on emitter transition there is additional direct tension that strengthens injection of holes from the emitter in base. The injected holes, reaching collector transition cause additional increase in current of a collector. As total collector current is proportional to coefficient of internal strengthening, increase of spectral sensitivity - reaching 0,65 takes place And/W. The purpose of work consists in studying of influence of a charging condition of nonequilibrium vacancies on processes occurring during radiation and silicon heat treatment with Nn =10^{16} cm^3, and also clarification of the mechanism of increase in integrated sensitivity of two-barrier structures of rather ordinary photo diodes.

In Figure 1 spectral characteristics of two-barrier structure before radiation are shown, at the room temperature at the return tension of Ucont. = 0B, and Ucont. = 0,5B. From drawing it is visible

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that with growth of the enclosed return shift on r-p-transition photocurrent increases what to lead to photosensitivity growth, at an optimum choice of the return tension on r-p-structure transition.

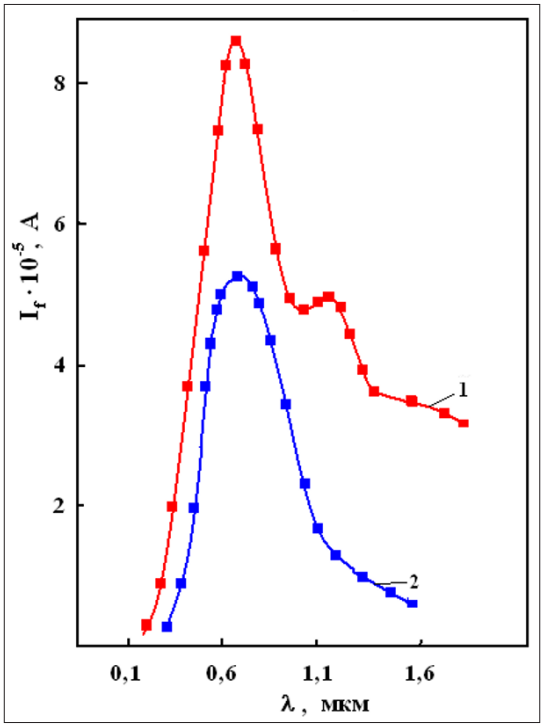

Figure 1: Spectral characteristic of the double-barrier structures a) to radiation

1.- $U_{rev.}$ = 0 V; 2.-$U_{rev.}$ = 0.5 V. T = 300 K

At further increase in Ucont. spectral sensitivity falls. Such behavior of Sλ connected with growth of area of a volume charge and improvement of coefficient of collecting of photocarriers. With a further growth of Ucont because of overlapping of zones, photoinjection of BSh is blocked and the structure works in a mode of one photo diode Figure 2.

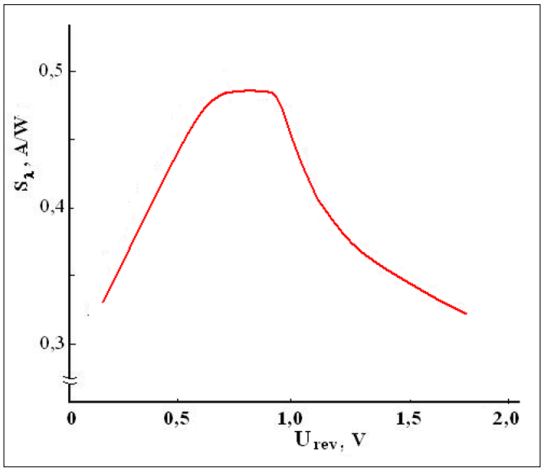

Figure 2: Dependence of the spectral sensitivity of the structure the applied reverse bias the p-n junction

The structure was irradiated at T=300 K in gamma quanta of Co^{60}. Isochronous (30 min.) annealing of radiation defects was carried out in the range of temperatures of Ta = 200-450 K. Method of photo MF of Voc = ln + ln =Vj+VB

I showed that primary radiation defects (RD) in p-Si crystals at 300 K are loaded positively.

The analysis VAC Figure 3 and spectral characteristics showed that recombinational currents increase in process of increase in a dose of radiation. Annealing of diodes leads to decrease in recombinational currents. At Ta temperature ≈ 300°C there is an annealing and reorganization of divakansiya to formation of the V2 complexes + O, and at Ta = 350°C the A-centers (V + O) and complexes (V2 + O) are actively annealed. The analysis of change of a current of through BSh and r-p-transition showed distinction of influence of annealing near a surface and in the depth of a crystal. It can be explained with growth of a photoresponse of BSh connected with accumulation of a charge and improvement of coefficient of collecting.

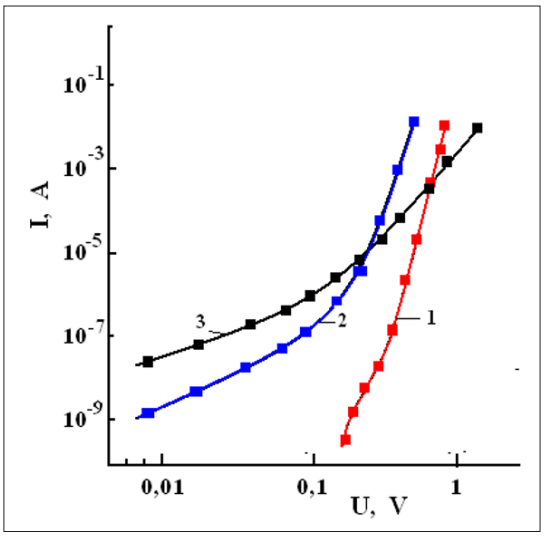

Figure 3: Volt-ampere characteristics of p-n-junction 1.original. 2. Dγ = 100 krad. 3. Dγ = 200 krad. Annealing results are insignificant

In Figure 4 curves of spectral dependence of photocurrent before and after radiation scale are represented at various doses and after annealing at T=400oC within 30 min. Annealing influences spectral characteristics slightly. With dose increase the radiation scale growth of photocurrent decreases.

Conclusions

Thus, it is possible to claim that the main role in electric losses the studied silicon structures is played by the oxygen-containing centers (V2+O and V + O). At increase in a dose of radiation and increase in temperature of annealing, feature VAC and spectral characteristics are caused by change of resistance of n-Si (basic area of structure), the caused accumulation (at increase in a dose) or disappearance and reorganization (when annealing) radiation defects. It is known that the speed of capture by defect of electrons and (or) holes first of all depends on the section of capture and the provision of power level in the forbidden zone. These parameters in fact are the "individual" characteristic of defect [3,4]. When annealing structures there is a reorganization of dot radiation defects and their disappearance. Thus mainly there is an accumulation of the same defects. Comparison to literary data shows that the main role in photo-electric losses of the studied structures is played by the oxygen-containing centers (V2+O and V+O). At further increase in a dose of radiation there

is an irreversible reduction of photosensitivity due to significant increase in resistance of base.

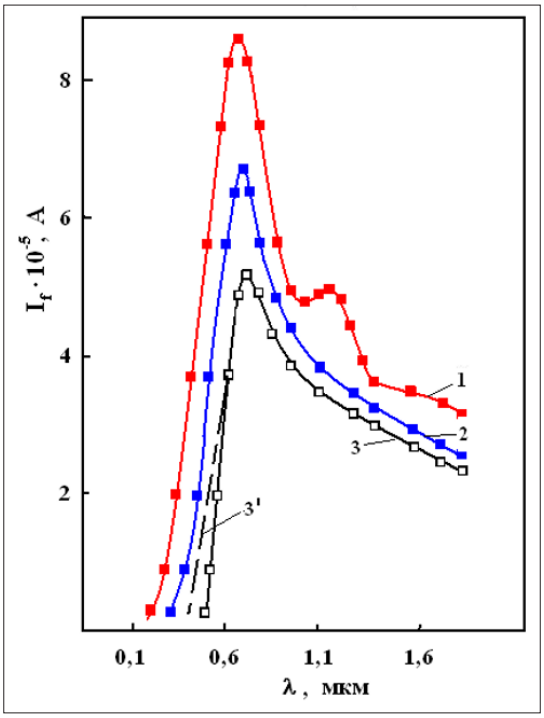

Figure 4: Spectral characteristic double-barrier structure after irradiation with gamma rays:1-up irradiation, 2-dose 150 krad., 3) dose of 200 krad., 3 ') annealed at T = 400 °C for 30 min

References

1. Sze SM. Physics of Semiconductor Devices, New York: Wiley. 1984. 455.
2. Bakaleynikov LA, Flegontova EJ, Pogrebitsky K, Eremin IV. Theoretical principles of semiconductor detector based on the p-n junction. Technical Physics. 2004. 9: 74.
3. Savchenko IV. Theoretical Foundations of dosimetry. 1985. 388.
4. Kosyachenko LA, Maslyanchuk EL, Rarenko IM, Sklyarchuk VM. Issledoanie carrier collection CdZnTe-ray detectors and - radiation photoelectrically. Semiconductors. 2004. 388: 1018.
5. Madatov RS, Mehrabova MA, Abasov FP. Fast acting detectors for - quantums on the Au-Si. The IV euroasian conference on nuclear science and its application. Baku, Azerbaijan. 2006. 145-14.
6. Madatov RS, Abasov FP, Mustafaev YuM. Effect of gamma irradiation on the photoelectric parameters of a silicon-based double-barrier structure. Russian conference on semiconductor problems Novosibirsk. 2011. 22-26.
7. Abasov FP. Preparation of thin films for the creation of solar cells. PHOTONICS. 2014. 272-90.
8. Abasov FP. Influence of gamma radiation on electrik propertien of silicon solar cells. Internatiolnal journal of Pure and Aplied Science and Technology. 2014 . 21: 12-16.2.
9. Abasov FP. Effect of gamma irradiation on electrophysical and photoelectric parameters of double-barrier structure based on silicon. Nuclear Science and its Application Vll Eurasian Conference Baku. 2014. 233.