# INVESTIGATION OF ELECTROPHYSICAL AND PHOTOELECTRICAL PROPERTIES OF $Ge_{1-X}Si_X$ /Ge HETEROSTRUCTURES OBTAINED BY MOLECULAR-BEAM EPITAXY METHOD

ABBASOV SH.M., AGAVERDIYEVA G.T., *IBRAHIMOV Z.A., *FARAJOVA U.T.
*Institute of Radiation Problems, Azerbaijan National Academy of Sciences*
**National Academy of Aviation*
*Phone: (+99412)4393-391; fax: (+99412)4398-318; e-mail: shabbasov@rambler.ru*

$Ge_{1-x}Si_x$/Ge solid solutions are considered one of perspective materials used in modern electronics. As the band-gap energy in these solutions is less than that of Si, but mobility of charge carriers is more than that of Si, these solutions are used to prepare heterostructure.

Nowadays transistors, anodes and integrated circuits distinguishing by their accuracy, mobility and restlessness have been developed on the base of $Ge_{1-x}Si_x$ solid solutions. $Ge_{1-x}Si_x$ solid solutions have been obtained by Czochralski method.

During the process the crystals were alloyed by boron and phosphorus. Crystals were cut into perpendicular boards from 30 up to 42 in diameter in <110> direction.

P-type $Ge_{1-x}Si_x$ boards polished like plate glass were used to develop diode structures. Here specific resistance of p-type $Ge_{1-x}Si_x$ boards was $\rho$=4.8 Ohm·sm, but specific resistance of n-type Ge boards was $\rho$= 5÷4.5 Ohm·sm, ıthickness of the boards ≈ 400 mkm.

After the heterostructure had been obtained, $p^+$ and $n^+$ layers of boron and phosphorus 8-10 mkm in depth were obtained from p- and n- sides of the sample and silicate glass by diffusion. The contact pieces were made of nickel.

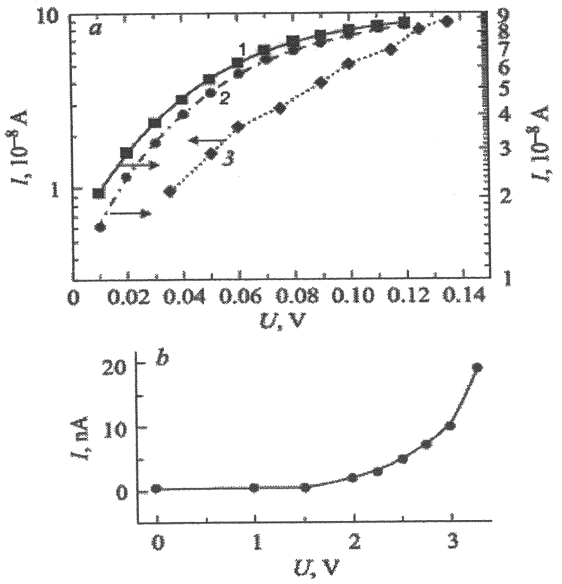


**Figure. 1.** 1 –proportional current-voltage characteristic, 2 – not proportional current- voltage characteristic

а – current-voltage characteristic for proportional street, б – for not proportional street.

1 – before radiation, 2 –after radiation 30 krad, 3 –100krad

Diode structures with the field ≈ 1sm² were cut from the obtained samples. Current-

voltage characteristic of the samples were measured at room temperature at constant current. In order to obtain thin $Ge_{1-x}Si_x$ (x= 0.10) on Ge substrate the sample from the side of $Ge_{1-x}Si_x$ was mechanochemically polished, so $Ge_{1-x}Si_x$ solution with ≈ 400 mkm density was obtained on thick Ge substrate. Elastic voltage and defects of the crystal structure were studied by X-ray topography method using continuous synchronous radiation.

It was revealed that variety of thermal expansion coefficients and parameters of $Ge_{1-x}Si_x$ and Ge crystal lattices leads to considerable increase of tension. At the result of this tension crystal lattice is exposed to elastic and plastic deformation.

Current-voltage characteristic of the samples obtained was measured before and after radiation.

As it seems from Figure 1. resistance of the samples increases after radiation and the current passing through the sample decreases.

It was determined that during radiation of $Ge_{1-x}Si_x$ (x=0÷0.15) solid solution linearity of current-voltage characteristic deteriorates and three fields are observed. These dependence shows that there are deep donor layers in restricted band of $Ge_{1-x}Si_x$ solid solution.

During the experiment after radiation defects generate in restricted band and their concentration increases simultaneously with the increase of radiation dose. n- $Ge_{1-x}Si_x$ solid solution is compensated after radiation and this provides its light-sensitivity.

For additional information photoconductivity of the samples at room temperature was measured.

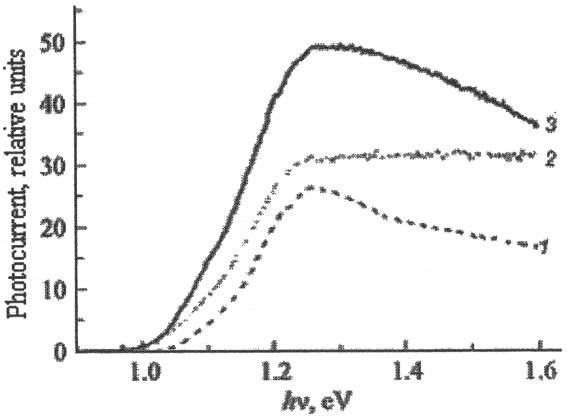


**Figure 2.** Photoconductivity of $Ge_{1-x}Si_x$ samples before and after radiation at room temperature
1 –before radiation, 2,3 – after radiation.

As it seems from Figure 2. light-sensitivity of the samples in heterostructures after radiation in $1.0 \leq h\nu \leq 1.11$ eV field has increased. The sensitivity of heterostructures increase more in comparison with that of solid solutions. The generation of this additional sensitivity can be manifested by deformation of crystal lattice as hypothesis in the meantime.