

## RADIATION DEFECTS IN n-TYPE GaAs

S. Marić, Institute of Physics, University of Sarajevo

M. Stojić, Laboratory of Solid State Physics, Institute of Nuclear Sciences "Boris Kidrič"-Vinča, Beograd

There is a certain number of papers on the radiation defects in GaAs<sup>(1,2,3)</sup>. By irradiation with fast electrons two annealing stages are observed<sup>(1,3)</sup>, whereas in the specimens irradiated with fast neutrons the annealing occurs via three stages<sup>(2)</sup>. Discussing these results, the radiation defects were considered as Ga or As vacancies, close Frenkel's pairs, and point defects clusters.

This work concerns our further study of lattice defects in n-type GaAs<sup>(4)</sup>. In order to compare quenched-in defects with those induced by irradiation, the similar specimens of n-type GaAs were used. The specimens were quenched by the earlier described procedure<sup>(4)</sup>, and irradiated in Vinča Institute Nuclear Reactor "RA" with the neutron flux of  $1.6 \times 10^{13}$  neutrons/cm<sup>2</sup>s. It was established that defects induced by quenching and neutron irradiation act as acceptors. The concentration of thermal defects in a specimen quenched from temperature  $T_q = 939\text{K}$  is  $7 \times 10^{15} \text{cm}^{-3}$ , in the irradiated specimens the concentration is in the range from  $2 \times 10^{15} \text{cm}^{-3}$  to  $1 \times 10^{16} \text{cm}^{-3}$ , depending on the irradiation time. The results of isochronal annealing of defects in thermally treated, only irradiated, and thermally treated plus irradiated specimens are presented in Fig.1. As can be seen from this Figure, the annealing of thermal defects occurs in two stages. In irradiated, and thermally treated and irradiated specimens three annealing stages are observed. The activation energies of these annealing

stages were determined by the change of slope method and by the variable temperature method<sup>(5)</sup>.

The first annealing stage appears at 250°C, with the activation energy  $E_{a1}=0.69$  eV, which presumably belongs to the recombination of close Frenkel's pairs.

The second stage, at the temperature of 380°C, exist in quenched, irradiated, and quenched plus irradiated specimens, with activation energies of 0.85 eV and 1.0 eV, respectively. The annealing of this stage is described by the kinetic of the first order. There are several physical reasons that the annealing stage belongs to the vacancies of gallium.

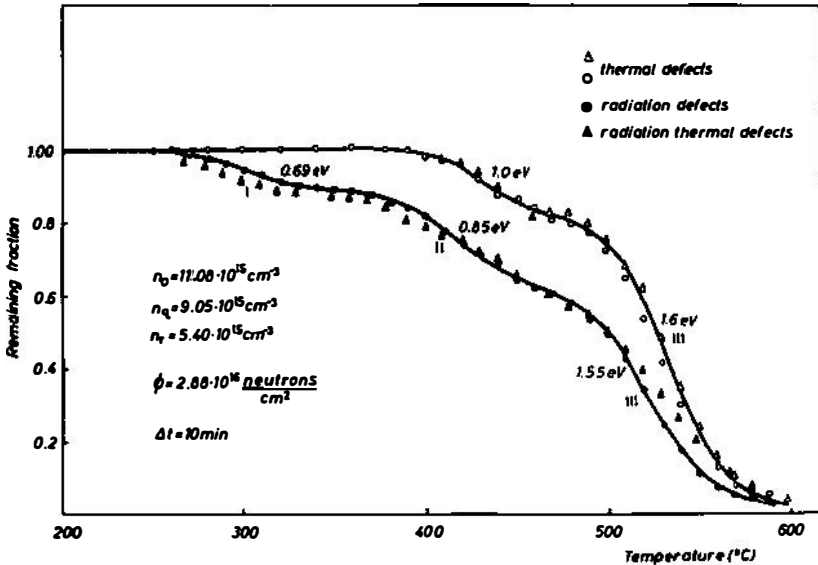


Fig.1 Ten minutes ( $\Delta t=10$  min) isochronal annealing of radiation and thermal defects in n-type GaAs:  $n_0$ ,  $n_q$  and  $n_r$  denote the concentrations of electrons before defects generation, after quenching and after irradiation, respectively.

The third stage at the temperature of  $490^{\circ}\text{C}$ , with the activation energy of  $E_{a3}=1.55-1.65$  eV, can be attributed to the complexes of point defects with impurities, or to the clusters of point defects.

Combining two methods for defect generation, the quenching and neutron irradiation, and comparing the results of defects annealing, one can conclude that in both cases the same defects are generated. Being acceptors, they are responsible for the conversion of GaAs from n into p-type.

#### References

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