"SWITCH" EFFECT OF IRRADIATED PN-JUNCTION

ЭФФЕКТ ПЕРЕКЛЮЧЕНИЯ ОБЛУЧЕННОГО ЭЛЕКТРОННО-ДЫРОЧНОГО ПЕРЕХОДА

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Silicon as a crystalline substance has been investigated for a long time from the point of view of resistance against radiation, and its partial amorphization was proved at critical values of the fluency of fast neutrons (e.g. [1]). The resistance to radiation of semiconductor elements produced on the basis of Si was investigated later [2], with a possible modification in the adjustments of such elements with regard to the applied fluency of radiations. It has been pointed out that the upper boundary of the fluency of fast neutrons where the PN-junction ceases fo fulfil its function is approximately 10^{15} m^{-2}.

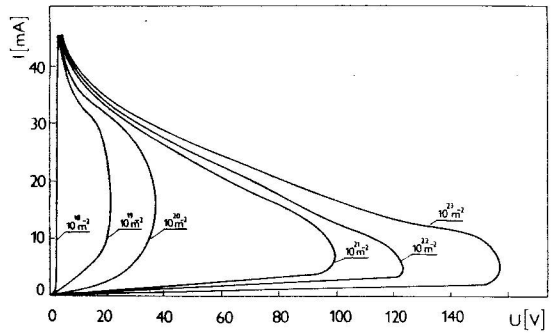

Fig. 1.

Our experiments on serially produced PN-junctions or semiconductor elements have proved the ability of the function of such an element, even in the case of rather high fluencies of fast neutrons, and the possibility of a regeneration of the qualities of PN-junctions even after an irradiation by fluencies of fast neutrons approximately 10^{21} m^{-2}. These facts are the subject of another publication.

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In our latest experiments — observing the changes of VA-characteristics of PN-junctions in the forward direction — we observed a (reproducible) "switch" effect for the samples irradiated by fluencies of fast neutrons $> 10^{18}$ m^{-2}, which is similar to the switch effect in amorphous semiconductors.

In Fig. 1 the forward branches of the VA characteristics of the PN-junctions (from which the KY 131 diodes are produced) are shown for the fluencies of fast neutrons (10^{18}—10^{23}) m^{-2}. These samples were irradiated in the reactor of the Institute of Nuclear Research of the Czechoslovak Academy of Sciences at Řež, where the ratio of fast to thermal neutrons was 2 : 1, the average of fast neutrons was 2 MeV, and the temperature at irradiation approximately 350 K.

The "switching" phenomenon, i.e. the existence of an area of negative resistance for intervals of a critical radiation observed only at higher temperatures in the forward direction can be explained:

1) by an amorphization of the crystalline structure of the PN-junction;

2) by a different influence of radiation disturbances in a asymmetrical P^+N-junction — this specifically concerns the areas of P^+ and N-silicon;

3) by a "field" activation of deep levels created by neutrons, in the case of suitable voltages at the PN-junction.

This — very interesting — "switching" phenomenon will be systematically studied in the following experimental researches from the point of view of structural changes, but also of changes of transport parameters at the PN-junction, where a practical application of this effect is obviously possible.

REFERENCES

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