when the current i^0 changes, it can be assumed that i_z is practically independent of i^0. Using the obtained value of i_z, we can construct the entire $S^0(i^0)$ plot (see Fig. 2). A comparison of the experimental and calculated curves of Fig. 2 with and without allowance for the Zener current confirms the considerations advanced above. According to the preliminary data obtained by means of this method, the Zener current density in germanium diffusion p-n junctions with breakdown voltage 12 V ($E_{max} \approx 2.5 \times 10^5$ V/cm, where E_{max} is the electric field intensity at the center of the p-n junction) is of the order of (0.5 - 1) x 10^{-2} A/cm^2, and if V_{br} = 6.5 V ($E_{max} \approx 3 \times 10^5$ V/cm) its order is 1 - 2 A/cm^2.

In conclusion, the author is grateful to V. M. Val'd-Perlov and V. V. Veits for preparing the diodes and to A. S. Tager for interest in the work and reviewing the manuscript.

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DONOR ACTION OF DISLOCATIONS IN InSb

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Submitted 15 November 1968
ZhETF Pis. Red. 9, No. 1, 37 - 40 (5 January 1969)

The distinguishing features of plastic deformation in the crystal lattice of InSb make it possible to obtain in the crystal either an excess of α dislocations (terminating on a row of In atoms) or β dislocations (terminating on Sb atoms), depending on the polarity of the sample, the direction of the flexure axis, and the bending moment [1].

In our earlier investigation of the influence of plastic deformation by bending on the electric properties of InSb crystals (deformation temperature -200°C) [1] we observed an acceptor action of the α dislocations. It was assumed that the possible mechanisms of the observed phenomena could be one of the following:

1. Direct acceptor action of the dislocations (electron capture by the "bump couplings").

2. An increase in the number of active acceptors as a result of diffusion and redistribution of the impurities in the dislocation field, and the increase of the number of point defects.

To check on the foregoing mechanisms of acceptor action, n-type InSb crystals were subjected to plastic bending at a still lower temperature, -150°C, at which the diffusion rate is decreased. This revealed no acceptor action of either the α or β dislocations (Fig. 1). Subsequent annealing of these crystals at 350°C for three hours exerted an appreciable acceptor action and the crystal exhibited a p-type conductivity (p = 8 x 10^{14} cm^{-1} at 100°K). On the basis of these data, it can be assumed that the change of the type of conductivity of the sample is due not to direct acceptor action of the α dislocations, but is due to the

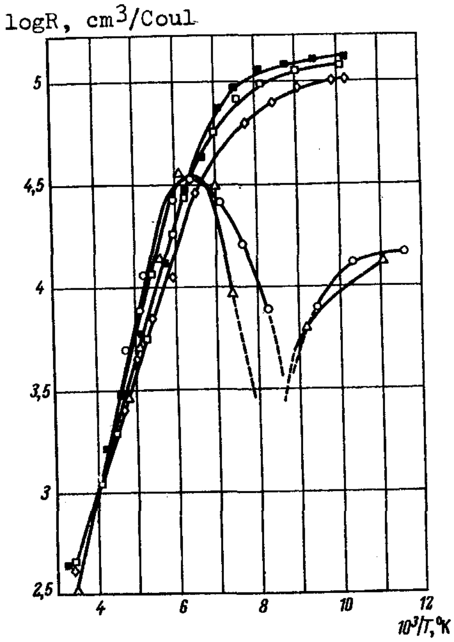

Fig. 1. Temperature dependence of the Hall constant for plastically deformed and subsequently annealed n-InSb samples. ■ - initial sample, donor electron density n - 5 x 10^{13} cm^{-3}; ◇ - with excess of α dislocations; □ - with excess of β dislocations; o - with excess of α dislocations after annealing; Δ - with excess of β dislocations after annealing.

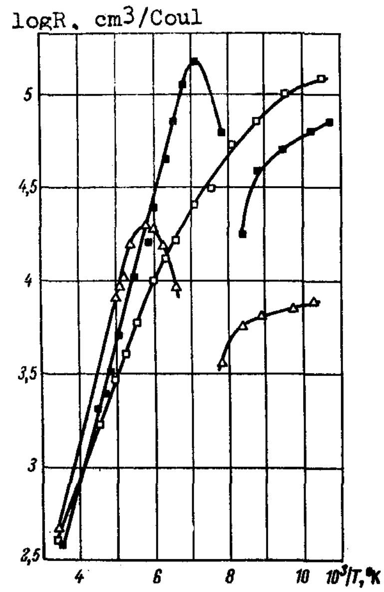

Fig. 2. Temperature dependence of the Hall constant of plastically deformed and subsequently deformed p-InSb samples. ■ - initial sample, hole density 5 x 10^{13} cm^{-3} ; □ - with excess of β dislocations; Δ - with excess of β dislocations after annealing.

redistribution of the impurities, in view of the fact that diffusion proceeds vigorously in the field of the dislocations produced by the bending. The earlier results [1] can thus be attributed to the relatively high deformation temperature, when the impurity redistribution is due to the diffusion during the course of the deformation itself.

We report in the present paper that we were able to observe, in addition, a direct donor action of β dislocations in p-InSb crystals. These experimental data are shown in Fig. 2. Following plastic deformation by bending, obtained by the procedure described by us in [1], at 150°C, such that excess β dislocations were produced in the crystal, a change was observed from p-type to n-type conductivity.

Subsequent annealing of these crystals led again to a change of the conductivity type, returning the crystals to p-type conductivity. Thus, the proper action of the β dislocations and the action of the subsequent annealing act in opposite directions in p-InSb crystals.

A quantitative analysis of the temperature variation of the conductivity of the deformed crystals suggests that a donor level of approximate depth 0.02 eV can be associated with the β dislocations in the investigated crystals.

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