EFFECT OF AN ELECTRICAL FIELD ON THE FILLING FACTOR OF DISLOCATION CORE

Rzaev S.G

Institute of Physics of the National Academy of sciences of Azerbaijan
AZ-1143 Baku, пр. Джавида 33

ABSTRACT

Exploring of Frenkul Pul effect in silicium the linear dependence of the filling factor of nonsaturated connections of a dislocation core from value of a cross electrical field is developed.

Keywords: dependence, filling factor, nonsaturated, electrical field.

I. INTRODUCTION

The small dimensions of the chips active components reduce to filling by defects a considerable part of their useful capacity as a result of increase of effect of defects to their parameters.. Therefore clarification of the mechanism and effect's features of the defects on electron processes in chips is an actual problem of solid-state microelectronics.

II. THE THEORETICAL ANALYSIS AND EXPERIMENT

From all known defects the edge dislocations have to be specially considered as result of their significant influence on electron processes in semi-conductors. According to Read's model [1], the edge dislocation in homopolar lattice is considered as an additional half-plane the edge what puts in crystal the string of non-saturated ("broken off") connections that are the dislocation core. Then it is possible to introduce a dislocation core as the one-dimensional periodic system with one electron on a unit cell which in approximation of Hartri Fox reduces to half-filled zone and to metallic conduction, but in approximation of Habbard where taking into account of the Coulomb's interaction between the electrons on the same atomic level reduces to extension of the energy band on entirely filled and empty area [2], where will be expected the behaviour of dislocation core as a dielectric. On the other hand the "broken off" connections of a dislocation core establishing the electron states in forbidden zone can behave as a trapping center and recombination. Thus, location can behaves itself like trapping, recombination centers and the high conductivity fields and dielectric.

Therefore study of electric properties of one isolated dislocation has a big scientific and practical interest. Valuable information about the electric properties of one isolated dislocation can give the researches of dependence of potential barrier height variation and a space charge (ПЗ) around of dislocation and it's conduction from an electrical field. These dislocation properties depending of direction and value of an electrical field are exhibited in a different degree.

In [3,4] we investigated in details the properties of one isolated dislocation depending of value and direction of an electrical field.

Because the potential barrier's height near the dislocation and the charge pattern are determined by nuclear state of dislocation core they will depend from the fill factor It is necessary to note the fill factors of the nucleus's non-saturated connections and the barrier height are changed under external electrical field effect. Therefore, for full description of the electrical properties of dislocation it is important to clarify the dependence character of the filled factor from electrical field.

Present article is devoted to researches of the filled factor dependence of non-saturated connections of nucleus's dislocation – f from electrical field – E.

Before to determine of filled factor dependence $-f$ from electrical field – E in [4] was experimentally determined the dependence of potential barrier's height variation -Δφ from E.

Knowing dependence Δφ from E , we shall use a known correlation for sticking factor of the charge carriers on deep centers [5]:

$$\eta = \frac{\Delta\varphi}{\varphi_0} \qquad (1)$$

$$\eta = \frac{\Delta f}{f_0} \qquad (2)$$

where φ_o and f_o – the potential barrier height and filled factor of Fermi in equilibrium conditions, $\Delta f = f - f_o$.

Knowing the dependence Δφ (E) and value φ_o that are determined above, by means of correlations (1) and (2) we shall determine the dependence of sticking factor of the carriers on dislocation deep centers from a cross

electrical field η(E). Further, knowing η(E) it is possible to determine the dependence of filled factor from the electrical field. Really from (1) and (2) we shall have:

$$f(E) = f_0\left[1 + \eta(E)\right] \qquad (3)$$

By substitute of experimental values to known expression for filled factor of Fermi (5) at E = 0 (equilibrium conditions) we shall have f_o = 0,1, that will well be matched by data (6). Dependence f (E) for one isolated dislocation is shown on fig. 1.

In drawing can see that this dependence has a linear character.

It is necessary to note that density and an atmosphere content of Kottrela strongly influent on filled factor and on charge pattern. These problems have to be specially considered.

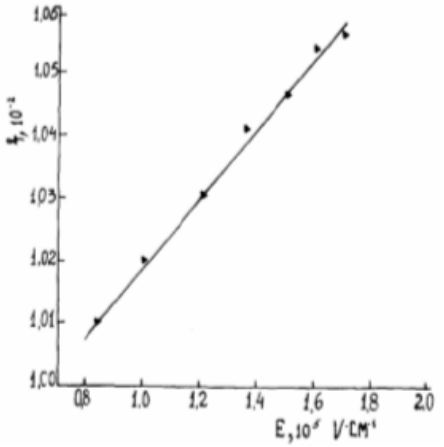

Fig.1
Dependence of the filled factor from an external electrical field.

III. CONCLUSIONS

1. It Is established that an electrical activity of the boundary charged dislocation is caused by non-saturated connections of atoms of its nucleus.
2. It is shown the linear dependence of filled factor of the non-saturated connections of dislocation's nucleus from the cross electrical field.

REFERENCES

[1.] Read W.T. - Phyl. Mag., 1955, 46, 111.

[2.] Madelung O. Kn. The Solid state physics. M. the Science. 1985.

[3.] Rzaev S.G., Nahmedov E.P. « "Metal-dielectric" transit and non-linear field dependence of conduction along the dislocation in Si ». ФТТ 1993, volume 4, page 1083-1042.

[4.] Rzaev S.G., Zahrabekova Z.M. « Effect of Frenkel-Pul on the charged dislocation in Si ». Azerbaijan NAS, News, FRTE series, 2004, № 2, p.106-109.

[5.] Matare G. "Defects electronics in semi-conductors", M, Mir, 1974.

[6]. Boyko I.I. and others. Physics of solid state, 1960, issue 2, p.109.