# REDISTRIBUTION OF IMPLANTED IONS OF OXYGEN IN IRON

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The purpose of the present work is definition of cinetics redistribution of implanted ions of oxygen in an iron sample (chemically pure) irradiated with ions of oxygen $O^+$. The sample was irradiated on the linear accelerator at the following parameters: energy of ions E =1.6 MeV; current I of =2 μA/cm²; time of an exposition is $10^5$ s; a irradiation dose is 1.15□$10^{18}$ ions $O^+$/cm²; the temperature of irradiation T=573K. The distribution of ions on depth (package TRIM) is well enough described by Gauss distribution. The implantation rate q, according to parameters of an irradiation, is given by expression (function of a source):

$$q = 1.15 \cdot 10^5 \frac{\sqrt{2}}{W\sqrt{\pi}} \exp\left[-2((x - x_c)/W^2\right] O^+/\mu m^2 s, \quad (1)$$

where W =0.157 μm; $x_c$ =0.848 μm.

Without taking into account diffusion and drift of ions distribution of oxygen on depth is given by a expression:

$$C(x, t) = q.t. \quad (2)$$

The gradient of concentration of ions C(x, t) will determine drift speed of ions in a field of pressure created by the introduced ions. Besides it is necessary to take into account diffusion of oxygen.

The differential equation are then:

$$\frac{\partial \tilde{N}}{\partial t} = D^2 \frac{\partial^2 C}{\partial t^2} + q - \frac{\partial}{\partial x}(uc), \quad (3)$$

with the beginning condition C(x, t =0) =0.

In the eq. (3) D is a diffusion coefficient of ions $O^-$ in a matrix; q is a function of a source (1); u - drift speed of ions.

We shall write down in an obvious kind expression for a drift member. Consideration we shall carry out within the framework of representations of radiation physics of solids. The spoor of deformation tensor $\varepsilon_{ee}$, caused by implantation of an ion of oxygen (placed in the octahedron or tetrahedron cavity of a crystal lattice), will be determined by expression:

$$\varepsilon_{ll} = C_{at}\frac{\delta\Omega}{\Omega}, \tag{4}$$

where $C_{at}$ is a concentration of ions of oxygen in at. un.; $\delta\Omega$ - change of volume of a matrix by an implanted ion; $\Omega$ (=$1.2.10^{-29}$ $m^3$) - volume of atom of a matrix.

Energy of interaction of an ion with field $\varepsilon_{ll}$ (4) is:

$$w = \frac{K}{2}\varepsilon_{ll}(\delta\Omega/\Omega^2)C, \tag{5}$$

where K is the module of compression.

The drift velocity u, in view of Einstein's ratio, is:

$$u = \frac{D}{kT}F = -\frac{D}{kT}\nabla w = -\frac{D}{kT}\frac{K}{2}(\delta\Omega/\Omega)^2\nabla C = -\alpha\nabla C. \tag{6}$$

Upon substitution of (6) in (3) is obtained:

$$\frac{\partial C}{\partial t} = D^2\frac{\partial^2 C}{\partial t^2} + q + \alpha\frac{\partial}{\partial x}\left(C\frac{\partial C}{\partial x}\right). \tag{7}$$

From these, the oxygen concentrations are found (finite element method, fig. 1).

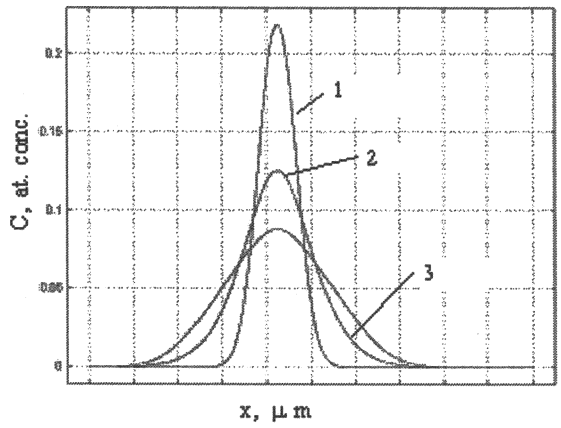



Fig. 1. Distribution implanted ions oxygen in iron; D = $2.29.10^{-7}$ $\mu m^2/s$; $\alpha = 1.10^{-16}$. A curve 1 - without taking into account diffusion and drift of ions; 2 - in view of diffusion, without drift; 3 - are taken into account both diffusion and drift of ions.