THE MECHANODIFFUSION MODEL OF THE INITIAL STAGE OF PARTICLES FLOW INTRODUCTION PROCESS IN A TARGET SURFACE*

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The paper presents a coupled mathematical model of the initial stage of particles penetration in the metal surface in non-isothermal approximation. It is assumed that the implanted material there is sufficient energy to generate mechanical disturbances into target surface at the interaction moment. And mechanical disturbances effect on the redistribution of diffusion of implanted particles.

The simplified one-dimensional model includes the heat conduction equation (1), equation of implanted component balance (2) and the motion equation (3):

$$\rho C_\sigma \frac{\partial T}{\partial t} + \alpha_T T \frac{\partial \sigma}{\partial t} = -\frac{\partial \mathbf{J}_q}{\partial x} \tag{1}$$

$$\rho \frac{\partial C}{\partial t} = -\frac{\partial \mathbf{J}}{\partial x} \tag{2}$$

$$\rho \frac{\partial^2 u}{\partial t^2} = \frac{\partial \sigma}{\partial x} \tag{3}$$

The govering relations correspond to the theory of generalized thermoelastic diffusion:

$$\mathbf{J} = -\rho D \frac{\partial C}{\partial x} + BC \frac{\partial \sigma}{\partial x} - t_D \frac{\partial \mathbf{J}}{\partial t} \tag{4}$$

$$\mathbf{J}_q = -\lambda_T \frac{\partial T}{\partial x} - t_q \frac{\partial \mathbf{J}_q}{\partial t} \tag{5}$$

$$\sigma = E\left[\varepsilon - \alpha_T (T - T_0) - \Delta\alpha (C - C_0)\right] \tag{6}$$

The model takes into account the finiteness of relaxation times of heat and mass fluxes and the interaction of waves of different physical nature — impurity concentration, stresses (strain) and temperature. The problem was solved numerically with using the double sweep method. The Fig.1 presents examples of coupled problem solving for materials system - Mo(Ni).

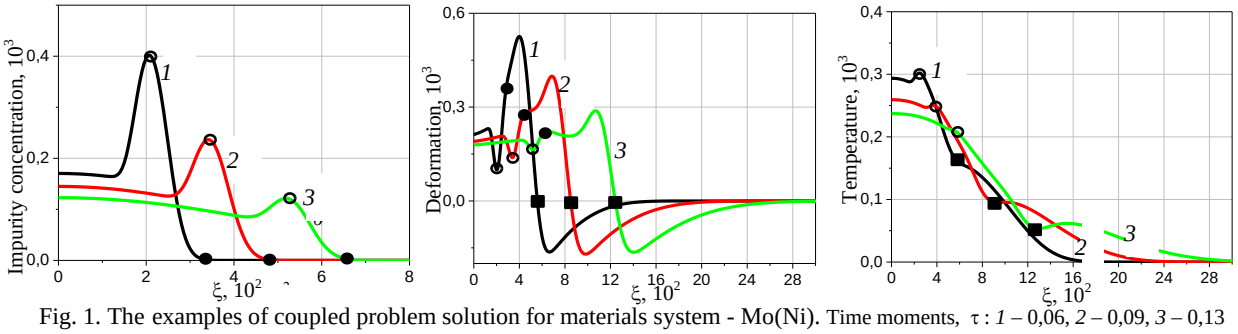

Fig. 1. The examples of coupled problem solution for materials system - Mo(Ni). Time moments, τ : *1* – 0,06, *2* – 0,09, *3* – 0,13

It is shown that the interaction of waves of different physical nature leads to the distribution of temperature and concentration do not correspond to the classical ideas (Fourier and Fick laws). The work demonstrated the distortions in the deformation and temperature waves which are the result of the interaction of the studied processes.

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