Nanocomposites and nanomaterials

Modelling of plastic deformation in binary alloys under irradiation and cyclic shear strain

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Investigation of the formation and dynamics of defects in constructional materials in the presence of external influences, in particular radiation and mechanical, is necessary for solving the problem of increasing the reliability and durability of such materials, because structural changes at a lower structural level determine the material behavior at the macrolevel. In this work the process of plastic flow and evolution of dislocation structure in binary alloys subjected to irradiation by high-energy particles and the external mechanical load is considered. The elastic inhomogeneity property, i.e., difference between elastic modulus of the alloy components, is taken into account, which is important in the study of phase transitions in materials containing components of different stiffness. The external mechanical loads are simulated in the form of cyclic shear strain. The numerical simulation of cyclic deformation process is of great theoretical and practical importance because experimental tests of materials under cyclic loads is quite time-consuming and expensive. The irradiation model is given by flux of additional athermal mixing of atoms of the system, that describes the processes ballistic diffusion of atoms [1]. Using the phase field model [2, 3] the evolution of dislocations and plastic deformations for the first two cycles of shear is simulated. The development of this model takes into account the redistribution of material composition in the presence of irradiation and mechanical loads. The dynamics of the stress-strain state in a binary alloy without irradiation and in irradiated alloy is studied. The diagram of the cyclic shear, the dependence of the free energy of the applied strain and the evolution of shear strain deviation are obtained.

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