S. M. Klotsman. *Structure, properties, and interactions of point defects and their influence on radiation-stimulated phenomena in metals.* 1. The principal changes in the properties of real materials that work under irradiation result from: a) accumulation of primary radiation-induced defects (RDs) and their transformations to secondary RDs; b) precipitation and solution of phases and redistribution of phases in space, clearly a result of diffusion processes that take place under extreme conditions. Of the many phenomena that occur under irradiation, we shall single out *radiation-stimulated segregation* (RSS) *and redistribution of alloy components under irradiation and radiation-induced embrittlement.*

2. The self-interstitial, the structure of which is determined from the diffuse and background scattering of x-rays,[1] is a dumbbell with [100] orientation in fcc crystals and [110] orientation in bcc crystals. When a self-interstitial forms, resonant modes with frequencies around 0.1 ω_{max} appear in the vibrational spectrum of the crystal. This accounts for the surprisingly high mobility of self-interstitials: they migrate through the crystal even at helium temperatures.[2] In this process,

some of them recombine with vacancies, and some encounter impurities the interaction with which is basically of elastic nature. When an interstitial interacts with an impurity, the impurity may transfer to an interstice with formation of a mixed dumbbell that has the same translational mobility as the self-interstitial.

3. Interstitials formed by irradiation at high enough temperatures diffuse to sinks (dislocations, grain boundaries, the surface). Mixed dumbbells formed along the path transfer the impurity to RD sinks, where the impurity concentration may exceed the average concentration in the volume of the solid solution by several orders of magnitude. We discovered the RSS phenomenon in strongly dilluted solid solutions of sulfur in nickel.[3-5] The residual resistivity of these solid solutions did not increase on accumulation of the RDs, but decreased with increasing fluence in the optimum temperature range. RSS is brought about under conditions such that both partners of Frenkel' interstitial pairs are mobile. Like interstitials, vacancies form complexes with impurities. Here the driving interaction is the Coulomb interaction of the excess screened charges of the vacancy and impurity. It is manifested in a linear decrease of the diffusion activation energy with increasing excess charge of impurities in the same row of the periodic table as the solvent.[6-9] The presence of a vacancy concentration gradient near an RD sink gives rise to fluxes of the alloy's components. The rapidly diffusing component is diverted from the sink into the interior, so that the sink is enriched in the slow component.

4. The development of RSS and the redistribution of the components on RD sinks result in high impurity concentrations and embrittling phases at the interfaces, which sharply weakens them. The plasticity of technical nickel irradiated with 6-MeV electrons (no transmutation helium is formed!) drops by factors of 2–2.5 as compared to unirradiated nickel.[10] The presence of helium has no influence on the plasticity of the original and irradiated nickel up to concentrations significantly higher than those developed in reactors. One possible way to suppress the harmful effects of RSS is to purify the material of harmful impurities and increase the number of RD sinks in order to ensure the necessary level of sink enrichment at a given production rate of mobile RDs.

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