

Overview

The Thirteenth International Symposium on Effects of Radiation on Materials was held in Seattle, WA on 23–25 June 1986. This biennial symposium series was begun in 1960 and has served as a major international forum for the exchange and discussion of both the fundamental and technological aspects of behavior change in materials exposed to radiation environments. The thirteenth symposium reached a record level of participation, necessitating its publication in two separate Special Technical Publications (STPs).

This volume contains the majority of the papers presented in those sessions directed toward the production by radiation of point defects, their subsequent diffusion, and their consequences on microstructural evolution, phase changes, and dimensional stability in metals. Most of the other papers presented at this symposium are published separately in ASTM STP 956, *Influence of Radiation on Material Properties*, which addresses primarily irradiation creep, creep rupture, and changes in mechanical properties of metals and alloys. Also included in STP 956 are papers on radiation damage in nonmetals, papers that describe irradiation facilities, and papers on the dosimetry of irradiation environments.

In the first section of this volume, *Radiation-Induced Defects and Their Diffusion*, several papers address the production and diffusion of point defects in various metals, exploring the effect of crystal structure, composition, and type of bombarding particle. Four of these papers investigate the collapse of defect cascades in materials ranging from pure metals to ordered alloys.

In *Neutron-Induced Swelling*, a large amount of recent data is presented that explores in a wide variety of face-centered cubic metals and alloys the dependence of void swelling on composition, metallurgical state, and reactor environment. One significant new conclusion is that compressive stresses are as effective as tensile stresses in accelerating the onset of swelling. Previous theoretical treatments had predicted that compressive stresses would retard swelling.

In *Charged Particle-Induced Swelling*, a variety of particles are used to simulate the swelling induced by neutrons. These particles include electrons, self-ions, and very energetic (600 MeV) protons. Several significant new conclusions are presented in these papers. First, it is shown that the compositional dependence of swelling in Fe-Cr-Ni alloys tends to be decreased upon addition of helium, suggesting that composition differences will exert less influence in fusion devices compared to fission devices. Second, it appears that in Fe-Mn-Cr alloys, iron is the element that segregates to sinks whereas in Fe-Ni-Cr alloys, it is nickel that segregates. This difference suggests that Fe-Cr-Mn alloys will be much more susceptible to formation of ferrite than are Fe-Ni-Cr alloys. Fe-Cr-Mn alloys have been proposed for fusion service.

In this STP, the section on *Theory of Swelling and Irradiation Creep* is much larger than that of previous symposia, reflecting the growing maturity of our understanding of these phenomena. Three papers address the influence of helium, and a number of others are concerned with the evolution and role of both pre-existing and radiation-induced microstructural components. Two papers address the compositional dependence of swelling, invoking the influence of composition on vacancy diffusivity. One paper is directed toward the swelling of metal fuel.

The experimental results presented in the *Microstructural Evolution* section cover a wide range of materials, environmental variables, and bombarding particles. A similar statement can be made concerning the section on *Solute Segregation and Phase Stability*. A variety of previously unexpected phase instabilities is uncovered in these two sections, indicating that much remains to be discovered concerning the influence of radiation on phase stability. It also appears that the displacement gradients inherent in charged particle irradiation have an even larger impact on solute segregation, phase stability, and swelling than previously thought possible.

The four papers in the last section of *Effects of Gas Implantation* explore the influence of gases, such as helium and hydrogen, on the damage introduced into a variety of materials ranging from metals and intermetallic compounds to metallic glasses.

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