Introduction

The 1972 Symposium on Effects of Radiation on Substructure and Mechanical Properties of Metals and Alloys was the sixth in a series of related international conferences that have been held biennially. The symposium, sponsored by ASTM Committee E-10 on Radioisotopes and Radiation Effects, had the primary objective of providing a forum for a comprehensive review of current technology in the development and evaluation of metallic materials for advanced nuclear reactor designs. This was accomplished by bringing together the world's experts in nuclear radiation effects on structural materials.

In the rapidly expanding field of reactor technology, there is a vital need to bring together those individuals performing laboratory research and conducting theoretical studies of a fundamental nature with reactor designers representing the nuclear industries, nuclear utilities, and government. This communication becomes even more critical in view of the requirement for standard procedures of evaluating materials performance and for the establishment of more stringent specifications for reactor structural materials.

The coupling of the number of atoms that have been displaced from their normal lattice positions in a metal, as well as the rate of atom displacements, due to exposure in a nuclear reactor environment, with changes in mechanical properties and in physical dimensions is rapidly replacing older measures of the radiation-induced transformations, such as the fluence of those neutrons above some specified energy or the nvt parameter. In essence, we are now beginning to report our irradiation data on the basis of the *primary effects*—generally denoted as radiation damage, but preferably should be designated as a *radiation-induced transformation.* On the other hand, *secondary effects*—more appropriately designated *radiation-effects,* refer to the changes in the physical or mechanical properties that can be measured in the macroscopic sense.

One of the major problems in radiation effects research is to identify the particular types of atomic scale radiation-induced transformation events that take place in an irradiated specimen from the particular combination or relative magnitudes or both of the radiation effects they produce. Conversely, another major problem in radiation effects research is to establish the types and relative magnitudes of the radiation effects that can result from a particular type of radiation-induced transformation. This circumstance becomes especially pronounced with the increased use of charged particle irradiations as a means of

accelerated studies in the effects of radiation to materials. The fact that a few hours of accelerator irradiations can produce radiation-induced transformations equivalent—as measured by the density and size of voids that are produced, for instance, to those produced by several years in reactors such as EBR-II—makes it even more important to standardize experimental techniques and test parameters.

In order to cover the important aspects of the general topic of radiation effects, 35 papers contributed by recognized experts from at least seven countries were carefully selected by the symposium committee and were arranged into six sessions. This volume is accordingly divided by session topic to facilitate the readers' review in terms of his preferred interest. A subject index is also included as a further aid in the review of the technology presented in this volume. The topics include (1) reactor vessel steels—fracture behavior, (2) reactor vessel steels—structure and impurity effects, (3) microstructural changes—neutron-induced voids and second phases, (4) microstructural changes—charged particle induced voids and computer experiments, (5) mechanical behavior—ductility, and (6) mechanical behavior—creep, fatigue, and tensile.

The use of the electron microscopy, as a means of correlating *radiation-induced transformations* with *radiation effects*, was quite apparent from this symposium. There should be no question that the observed microstructure of irradiated metals and alloys, as a common denominator, plays a key role in the interpretation of experimental data and in the development of theories and models on which engineers may predict changes in the performance of reactor components as a function of time-temperature and stress while in a nuclear environment. This circumstance was clearly revealed in the detailed discussions that followed many of the papers. The authors and attendees are commended for their excellent presentations and participation in this exciting field of radiation effects to metals and alloys.

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