Introduction

Biennally, ASTM Committee E-10 on Nuclear Application and Measurement of Radiation Effects sponsors an international conference to discuss the effects of radiation on structural materials. The 1974 symposium on "Properties of Reactor Structural Alloys After Neutron or Particle Irradiation" was the seventh in this series of conferences. The symposia provide the leading authorities in the field a forum for discussions and a comprehensive review of current and developing technologies.

In the complex field of nuclear reactor technology, there is a vital need to bring together those individuals performing laboratory research and conducting theoretical studies with those individuals responsible for the design, construction, and operation of the reactor. This need for improved communications becomes more important as the field broadens and the need for materials reliability intensifies.

The keynote address for the symposium, "How Can We Get Reliable Materials for Nuclear Power" was given by Dr. E. Zebroski of the Electric Power Research Institute. His address, which is not published in this volume, emphasized the need for more thorough understanding of materials behavior with the ultimate goal of achieving greater reliability for nuclear power plants.

Light water reactors have been in operation for over a decade, yet there still exists a need for a better understanding of the effects of irradiation on the properties of reactor vessel steels. The residual element content of these steels have a strong influence on the degree to which the steels are affected by irradiation. This discovery has led to a better understanding of how to minimize these effects. With the increased licensing restrictions, this knowledge will lead to the selection of materials that will provide the necessary degree of reliability.

The total neutron fluence received by the core and structural materials in the advanced reactors is quite large. Exposing experimental materials to this fluence in existing test reactors is costly and time consuming. Consequently, considerable effort has been made in recent years to simulate the effects of fast neutron irradiation. Several papers were presented at the 1972 symposium in which an attempt was made to couple

the number of atoms that have been displaced from their normal lattice position in the metal with changes in mechanical properties and density. Some of these techniques have been proven to have considerable potential and an entirely new technology emerged.

The importance of exploiting this new technology can be seen when one compares the time required to produce the same number of displacements per atom by simulation with that encountered in a reactor. A few hours of irradiation in an accelerator or particle irradiator can produce radiation-induced transformations, property changes, and swelling that would require several years to achieve in a fast breeder reactor. Because of the importance of this technology, almost half of the papers in the 1974 symposium were related to particle irradiation and irradiation simulation.

In arranging the symposium, an attempt was made to have a session on structural materials for controlled thermonuclear reactors (CTR). Materials problems in the CTR will be complex, however the current development effort for the CTR is more related to a better understanding of the process than to materials development. Because of the limited activities on materials, the goal to have a session on CTR materials did not materialize. However, an excellent introduction to the problem was provided by Kulcinski et al in their paper, "Comparison of Displacement and Gas Production Rates in Current Fission and Future Fusion Reactors."

The symposium consisted of about 45 papers contributed by recognized authorities from several different countries. Most of these papers were accepted for publication in this STP. The symposium and the STP are divided into five sections to facilitate the reader's particular interest. The topics include (1) Thermal Reactor Materials—Reactor Vessel Steels Theory, (2) Thermal Reactor Materials—Effects on Mechanical Properties, (3) Creep of Structural Materials, (4) Voids Caused by Irradiation, and (5) Irradiation Simulation.

Electron microscopy has become an extremely useful tool for evaluating the effects of irradiation on the microstructure of materials. Because of the complex nature of this tool, there is a need to standardize procedures and techniques. Committee E-10 has recognized this need and recently established a subcommittee, Description of Radiation Damage in Metals Using Electron Microscopy, to work in this area. During the 1974 symposium, this subcommittee held an evening workshop on "Radiation Damage in Metals Using Transmission Electron Microscopy." This workshop provided an excellent opportunity for those working in the field to discuss the ramifications of the various techniques.

The members of the symposium committee were C. J. Baroch, Chairman; F. R. Shober, Co-Chairman; A. J. Birkle, J. Moteff, C. Z. Serpan,

L. E. Steele, and K. M. Zwilsky. The symposium committee gratefully acknowledges the assistance of L. E. Steele, Chairman of ASTM Committee E-10, for his leadership and encouragement.

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