

EFFECTS OF RADIATION on MATERIALS

20th International Symposium

Stan T. Rosinski
Martin L. Grossbeck
Todd R. Allen
Arvind S. Kumar

EDITORS

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***Effects of Radiation
on Materials:
20th International Symposium***

*Stan T. Rosinski, Martin L. Grossbeck, Todd R. Allen,
and Arvind S. Kumar, editors*

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Dedication



ARTHUR L. LOWE, JR.

1927-1999

Art Lowe's career spanned 48 years, starting in 1951. This included nearly 37 years with the Babcock & Wilcox Company in Lynchburg, VA. He had a leadership role in the application of materials for nuclear fuel cladding and internals, the development of the reactor pressure vessel surveillance program, and in the evaluation of radiation effects on materials. Art shared his knowledge and experience for over 30 years as an active member of Subcommittee E10.02 on Behavior and Use of Nuclear Structural Materials. He has served on numerous other ASTM subcommittees concerned with the testing and evaluation of reactor pressure vessels, fuel cladding, and reactor internals. In 1997 Art was presented with the Peter Hedgecock Award in recognition of his dedication to the activities of Committee E10. His efforts led to the development and refinement of numerous standards, to the presentation of many technical papers in the Effects of Radiation on Materials symposia series and other international forums, and to advancement of the materials technology used in nuclear power plants. He has been a mentor to many, and a valued advisor to all. He will be missed greatly.

Foreword

This publication, *Effects of Radiation on Materials: 20th International Symposium*, contains selected papers presented at the 20th Symposium on Effects of Radiation on Materials, held 6–8 June, 2000 in Williamsburg, Virginia. The symposium was sponsored by ASTM Committee E10 on Nuclear Technology and Applications. The symposium chairman was Stan T. Rosinski, Electric Power Research Institute. Martin L. Grossbeck, Oak Ridge National Laboratory, Todd R. Allen, Argonne National Laboratory, and Arvind S. Kumar, University of Missouri-Rolla served as co-chairmen.

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Overview

ASTM Committee E10 on Nuclear Technology and Applications sponsors a biennial series of symposia on the effects of radiation on materials. The first symposium was held in 1960 and followed an earlier series begun in 1956 by Committee E10, then called the Committee on Radioisotopes and Radiation Effects. The meetings continue to be a major international forum for the presentation and discussion of research on the influence of radiation on the microstructure and mechanical properties of structural materials. In recent symposia, emphasis has also been placed on the advancement of emerging technologies to improve integrity assessment of major nuclear plant components (e.g., Master Curve fracture toughness methodology) in support of extended plant operation. The proceedings of the Twentieth International Symposium on the Effects of Radiation on Materials are published in this ASTM Special Technical Publication (STP) 1405. The Symposium was held 6–8 June, 2000, in Williamsburg, Virginia.

As demonstrated in previous symposia in this series, the Twentieth Symposium continued the tradition of strong international participation. The 98 registrants for the Twentieth Symposium represented 15 countries and 53% of the participants were from countries other than the U.S. One hundred thirteen presentations were scheduled to be discussed during the Twentieth Symposium and, of the 57 papers in this STP, 67% have corresponding authors from countries other than the U.S. The high level of international collaboration experienced in previous symposia was also apparent in this symposium. Committee E10 considers such international participation important to the success of this series of symposia and to standards development in support of nuclear technology and applications. The organizers extend their appreciation of those international researchers for their participation and the excellent quality of presentations.

The papers presented in this STP are organized in nine sections, four on reactor pressure vessel (RPV) steels, one each on austenitic and ferritic/martensitic alloys, one on proton and spallation neutron sources, one on radiation damage fundamentals, and the final section on other materials. As typical for recent symposia in this series, a large percentage of the papers in this STP (44%) deal with RPV steels and RPV integrity.

The first four sections contain 25 papers that discuss various aspects of radiation effects on RPV plate, forging, and weld materials, including radiation-induced changes on mechanical properties, radiation damage mechanisms and associated microstructural changes, and the modeling of radiation embrittlement mechanisms. A section is also devoted to discussion of the Master Curve fracture toughness methodology for application to RPV integrity assessment.

The section on austenitic alloys contains eight papers on various aspects of radiation-induced segregation, creep, irradiation-creep, swelling, and the associated changes in mechanical properties.

Four papers are presented in the section of ferritic/martensitic alloys. Topics discussed include characterization of fatigue properties and evaluation of the microstructural stability in reduced activation ferritic/martensitic steels, the characterization of post-irradiation deformation microstructures in ferritic Fe-Cr alloys, and the evaluation of thermal creep and irradiation creep properties of HT9 materials.

The section on proton and spallation neutron sources contains six papers that examine the effects of high energy proton and spallation neutrons on the mechanical properties and corrosion behavior of various structural alloys.

Four papers are presented in the section on radiation damage fundamentals. Topics discussed include microstructural evolution in martensitic steels and Fe-Cu alloys, the characterization of displacement cascades in austenitic steels, and phase boundary microstructure in nickel and manganese containing stainless steel alloys.

The STP concludes with a section containing ten papers covering a broad range of materials including vanadium alloys, tungsten rods used in the production of tritium, silicon film, silicon carbide and silicon carbide composites, shape-memory alloys, zirconium-niobium pressure tube materials, and other metals and alloys.

The diversity in subject material and the technical quality of the research presented in this STP reflect the continuing importance of the study of radiation effects on materials to the international scientific community and to the nuclear industry. This series of symposia will continue to provide a key international forum for the discussion of radiation effects on materials. On behalf of the editors, I extend my appreciation to all authors for their contributions and to the technical reviewers whose diligence helped maintain the tradition of excellence shown in this series of symposia and contributed significantly to the timely publication of this STP.

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