Materials Stability and Environmental Degradation
Materials Stability and Environmental Degradation

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EDITORS:

A. Barkatt
The Catholic University of America, Washington, D.C., U.S.A.

E.D. Verink, Jr.
University of Florida, Gainesville, Florida, U.S.A.

L.R. Smith
National Bureau of Standards, Gaithersburg, Maryland, U.S.A.
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Preface

This book contains most of the papers presented at the symposium "Materials Stability and Environmental Degradation" held as part of the 1988 MRS Spring Meeting, Reno, Nevada, April 5-8, 1988.

The symposium covered a broad range of subjects related to materials stability and corrosion phenomena, but several themes were repeatedly emphasized. In the search for high-performance materials in aggressive environments, stability and corrosion resistance, rather than cost and ease of fabrication, have become the primary considerations. Combinations of materials, rather than single materials, are needed in many cases to satisfy such needs. Understanding of corrosion and degradation mechanisms is a key element in the development of resistant materials, and studies of these mechanisms in different types of materials—metals, crystalline ceramics, and glasses—exhibit a surprisingly high potential for correlation and cross-fertilization.

Specifically, carbon/carbon composites have become the materials of choice for applications requiring high tensile strength and light weight at temperatures between 2000°F and 3200°F despite their high cost ($11,000/lb). Such applications include aircraft brake discs, missile nose tips, and rocket nozzle throats and exit cones. To provide oxidation resistance for such composites in space shuttle nose caps and wing leading edges, gas turbine engine components and missile propulsion components, such composites have to be coated with ceramic coatings. These and lower-temperature composites will be extensively used in the National Air and Space Plane project (NASP). The development of such materials is based on study of the mechanisms of oxidation, volatilization, mutual chemical interaction, crack formation and attack by moisture.

The development of unifying thermodynamic and kinetic models of materials corrosion has already contributed to significant progress in several areas and is likely to have much greater impact in the future. The development and application of Pourbaix (pH-Eh) diagrams for the stability of materials over a wide range of environmental conditions, initially used in metal corrosion, has been shown in this Symposium to provide a firm basis for the safe use of borosilicate glasses as immobilization media for high level nuclear waste over periods of $10^3$-10^5 years in geologic repository. At the same time, the use of stability diagrams in the identification of stable phases which appear in natural minerals has made it possible to analyze the effects of acid rain and to lay the ground for combating corrosion effects, e.g., in the restoration of the Statue of Liberty. Systematic studies of the reactivity of glass surfaces have given rise to identification of regions of glass composition which are sufficiently reactive to bond to human bone and soft tissue yet durable enough to resist dissolution in the body and are consequently suitable for use in implants.

An area where fundamental mechanistic studies have resulted in major improvements in safety and large cost savings is stress corrosion in ceramics, glasses, and metals. Beneficial results of basic crack propagation studies were reported in this
Symposium in applications as diverse as surgical implants on one hand and nuclear reactor components on the other.

A joint session with the symposium on "Materials Issues in Art and Archaeology" was held to deal with common approaches to the deterioration of natural, ancient and modern glass.

This was the first symposium on general issues of corrosion and durability to be held by the Materials Research Society. It is hoped that further efforts to bring together researchers who work on the basic mechanisms of corrosion of widely differing types of materials, will continue with beneficial results to the development of corrosion science.

Aaron Barkatt
Ellis D. Verink, Jr.
Leslie R. Smith
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Very special thanks are due to Stephanie Ann Olszowka who acted as Executive Assistant and Proceedings Coordinator throughout this endeavor. Her dedicated effort was invaluable throughout all of the stages of the organization of the symposium and the proceedings, including the Call for Papers, collation of the abstracts, handling of the manuscripts, and the refereeing process.
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