THERMOMECHANICAL FATIGUE BEHAVIOR OF MATERIALS: 4TH VOLUME

Technical Editors:
Michael A. McGaw, Sreeramesh Kalluri
Johan Bressers, Stathis D. Peteves

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Foreword

This publication, *Thermomechanical Fatigue Behavior of Materials: 4th Volume*, contains papers presented at the Fourth Symposium on Thermomechanical Fatigue Behavior of Materials, held in Dallas, Texas on November 7–8, 2001. The Symposium was sponsored by ASTM Committee E08 on Fatigue and Fracture and its Subcommittee E08.05 on Cyclic Deformation and Fatigue Crack Formation. Symposium co-chairmen and publication editors were Michael A. McGaw, McGaw Technology, Inc.; Sreeramesh Kalluri, Ohio Aerospace Institute, NASA Glenn Research Center at Lewis Field; Johan Bressers (Retired), Institute for Energy, European Commission - Joint Research Center; and Stathis D. Peteves, Institute for Energy, European Commission - Joint Research Center.

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Overview

Thermal fatigue and thermomechanical fatigue (TMF) of structural materials have been topics of intense research interest among materials scientists and engineers for over fifty years, and are subjects that continue to receive considerable attention. Several symposia have been sponsored by ASTM on these two topics over the previous thirty years, and have resulted in Special Technical Publications (STPs) 612, 1186, 1263, and 1371. The Fourth Symposium on Thermomechanical Fatigue Behavior of Materials was held at a time when significant efforts have been underway both in the U.S., under the auspices of ASTM, and internationally, under the auspices of ISO, to develop standards for thermomechanical fatigue testing of materials. This STP represents a continuation of the effort to disseminate all aspects of thermomechanical fatigue behavior of materials from a wide variety of disciplines. The materials scientist, for example, seeks a deeper understanding of the mechanisms by which deformation and damage develop, how they are influenced by microstructure, and how this microstructure may be tailored to a specific application. The analyst wishes to develop engineering relationships and mathematical models that describe constitutive and damage evolution behaviors of materials. Ultimately, the designer seeks engineering tools and test methods to reliably and economically create load-bearing structures subjected to cyclic, thermally-induced loads.

The present STP continues the trend of past symposia of strong international participation. The twenty-one contributed papers in this STP have been organized into four sections. The first section is on Thermomechanical Deformation Behavior and Modeling. Continuation of rapid advances in computational technology has provided greater opportunity than ever before to enable the identification and characterization of the complex viscoplastic deformation of materials under thermomechanical conditions, and this section's collection of five papers is a consequence of these endeavors. Notable among these is the paper, "Cyclic Behavior of Al319-T7B Under Isothermal and Non-Isothermal Conditions," by C. C. Engler-Pinto, Jr., H. Sehitoglu, and H. J. Maier, as it received the Best Presented Paper Award at the Symposium. The second section, Damage Mechanisms under Thermomechanical Fatigue, contains four contributions addressing coated alloys, single crystal nickel-base superalloys, and titanium aluminide materials. The third section, Thermomechanical Fatigue Behavior and Cyclic Life Prediction, contains the following seven contributions: an approach utilizing fracture mechanics for TMF life prediction, a contribution on coated TMF behavior of a monocrystalline superalloy, a collaborative, round-robin style effort to characterize behaviors of uncoated and coated superalloys under TMF conditions, a work on complex loading effects, and two contributions dealing, significantly, with applications in the automotive arena. The fourth and final section addresses Experimental Techniques for Themomechanical Testing. Too often, especially in thermomechanical fatigue, experimental details are given secondary importance in the literature, when in reality the conduct of thermomechanical fatigue tests requires unusually fine attention to detail and practice. Here again, the tremendous advances in computer technology have enabled the development and implementation of sophisticated testing techniques. The five papers in this section are reflective of these advances, and can be read with profit by the experimentalist interested in establishing or improving thermomechanical fatigue testing capability.

Finally, we would like to express our sincere gratitude to the authors, the reviewers, and ASTM staff (Ms. Dorothy Fitzpatrick, Ms. Crystal Kemp, Ms. Maria Langiewicz, Ms. Christina Painton, Ms.

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Michael A. McGaw
McGaw Technology, Inc.
Fairview Park, Ohio
Symposium Co-Chairman and Editor

Sreeramesh Kalluri
Ohio Aerospace Institute
NASA Glenn Research Center at Lewis Field
Brook Park, Ohio
Symposium Co-Chairman and Editor

Johan Bressers
Institute for Energy, JRC-EC (Retired)
Petten, The Netherlands
Symposium Co-Chairman and Editor

Stathis D. Peteves
Institute for Energy, JRC-EC
Petten, The Netherlands
Symposium Co-Chairman and Editor

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