



*Cyclic
Deformation,
Fracture, and
Nondestructive
Evaluation of*

Advanced Materials

S E C O N D V O L U M E

*M. R. Mitchell and
Otto Buck, editors*



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and Nondestructive Evaluation
of Advanced Materials:
Second Volume***

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The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

Foreword

This publication, *Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials: Second Volume*, contains papers presented at the Second Symposium on Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials, which was held in Miami, Florida, 16–17 Nov. 1992. The symposium was sponsored by ASTM Committee E-8 on Fatigue and Fracture. The symposium co-chairmen were M. R. Mitchell, Rockwell International Science Center, Thousands Oaks, California, and Otto Buck, Ames Laboratory, Iowa State University, Ames, Iowa.

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Overview

About two years have passed since the proceedings of the First Symposium on Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials (ASTM STP 1157) were published. As intended, and due to the success of this first symposium, the Second Symposium was held in November 1992 in Miami, Florida, on the same topics, with even greater participation of an international technical community demonstrating an enhanced interest in the implementation and use of engineered advanced metallic, ceramic, and polymeric materials and composites thereof. These materials are now finding their way into structural and engine applications, usually by "insertion programs." However, due to their complex nature, there is still a lot to be learned about their processing, as well as their fatigue and fracture behavior under the service conditions they are exposed to. Inspection methods for the detection of materials damage are, to a large degree, still in their infancy. Their development will clearly be of fundamental importance such that the results can be correlated with the components' remaining life for improved reliability in a fitness-for-service dominated strategy. Academic institutions and aerospace-related research laboratories, as well as industry, have contributed to these proceedings to provide a well-balanced overview of the state-of-the-art of this subject matter.

The first part of the book covers fatigue crack initiation, crack growth, and fracture toughness of advanced structural materials such as silicon nitride, special titanium alloys and steels, particle-reinforced aluminum alloys, cobalt-based alloys, thermoplastics, and graphite-epoxy composites. In some cases, the effects of crack closure as well as crack bridging on fatigue crack growth are discussed. Discussions also include complex multiaxial cyclic deformation and creep behavior. Effects of thermal fatigue on coatings and their optical properties are reported. Other interesting applications include the fatigue and fracture properties of high-strength, high-conductivity alloys, useful to the electric power industry.

The remainder of the book is dedicated to the nondestructive evaluation of advanced materials that may have manufacturing defects and/or have experienced in-service damage. Still very popular for defect and damage detection in these materials is the so-called acoustic-ultrasonic technique, which is a sophisticated form of coin-tapping. In one case, the change of the materials' compliance has been correlated to the overall damage. On the other hand, micro-focus X-rays provide information on the location of the defects, as can focused ultrasonic beams in weldments.

The symposium chairmen appreciate, certainly, the cooperation and diligence of the authors of the manuscripts. Each manuscript was thoroughly reviewed by at least three experts in the field. The assistance of the ASTM staff in coordinating the publication efforts is very much appreciated and made our lives so much easier. We, the organizers, hope that we have another opportunity for bringing such a group of experts together at a Third Symposium on Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials.

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