Composite Materials Science and Engineering

K.K. Chawla
(Springer-Verlag, 1987)

Prof. Chawla has attempted the formidable task of including essentially all types of fiber composite materials and their properties in a single text. By employing an economic writing style and carefully selected references, figures, and suggested readings, he has successfully produced a relatively short but thorough 292-page book.

The book is divided into three parts. The first deals with the constituents of composite materials: fibers, matrix materials, and interfaces. Unlike most previous treatments, the author discusses polymer, metal, and ceramic matrix materials equally. He also lists some of the desirable and undesirable engineering features of each class of fiber and matrix.

Part II deals with the fabrication and properties of each class of composite. In addition, discussions of both carbon fiber-carbon matrix composites and multifilamentary superconducting composites are included. The latter composites are rarely mentioned in the literature but are in fact the most highly developed form of metal matrix composite.

In Part III, which treats micromechanics, macromechanics, and strength, the author condenses many of the classical anisotropic elasticity results used in the design of composite structures. Also included are strength and failure modes for various composites, appendices on matrix algebra and fiber packing, and a selection of problems for course use.

Throughout the book, the author offers insights and cautions. He does not just repeat a development verbatim; rather, he inserts opinions and explanations which simplify the concept in the reader's mind. One example is his discussion of constitutive relationships in laminated plates. Instead of just listing the governing equations for the A, B, and D matrices, he presents simple physical examples to explain how the various deformations, forces, and moments are coupled—often in a non-obvious manner. The author attempts to inject realism and personal experience into the text whenever possible.

In any survey treatment, there are bound to be certain topics that could have been further developed. The author might have devoted more space to polymer matrix composites, which are more widely used than metal and ceramic matrix materials. He might also have discussed time-dependent failure and the effect of temperature on properties more completely. Corrosion, moisture and oxidation also are life-limiting issues for certain composites, which perhaps could be included in a later edition.

Clear, concise, and complete, this book is an excellent up-to-date introduction to fiber composite materials. I would recommend it for a first course in composite materials at the advanced undergraduate or first-year graduate level. It is also valuable for the practicing engineer or scientist who wishes to become familiar with the growing field of fiber composites.

Reviewer: F.P. Gerstle, Jr. is supervisor of ceramics development at Sandia National Laboratories. His research interests are in residual stresses in ceramics, fracture of interfaces, and fibrous composite materials.

Fracture at High Temperatures

Herman Riedel
(Springer-Verlag, 1986)

Riedel's treatise on the mechanisms and mechanics of fracture at high temperatures is remarkably well researched and comprehensive. An important contributor to this field, the author is well qualified to write on the subject. The book is unique in combining a fundamental mechanistic approach to this complex field of materials behavior with a practical engineering approach that should be very useful in design of high temperature components for power production systems.

Twenty-eight chapters are divided into three major parts. The first part contains four introductory chapters on basic tools for dealing with fracture problems in creeping materials, such as mechanisms of creep deformation, forms of creep fracture, continuum mechanics, and mechanisms of diffusion.

The second part, which includes 15 chapters, details the microstructural mechanisms resulting in creep damage and kinetics of their development under stress. Considered are the nucleation and growth of cavities on grain boundaries which are affected intrinsically by the presence of grain boundary particles and extrinsically by environmental influences. Other considerations include embrittlement due to segregation of cohesion-impairing trace impurities to grain boundaries.

In the last part of the book containing nine chapters, the author discusses the various modes and mechanisms in which macroscopic creep cracks grow. He provides useful engineering scaling laws for several different regimes, including transient and steady state growth in both partly creep relaxed structures as well as structures with fully developed creep flow around cracks. The author has made principal contributions to the field in this area, and the concise summaries of the different regimes reflect this expertise.

At each level the author has provided a clear, readable assessment of extensive developments in both materials science and fracture mechanics. This represents a major contribution to the understanding of this complex and technologically very important field. Additionally, this work is unique in its thorough coverage of a subject that combines discriminating coverage in several fields. With more than 600 references ranging from fundamental mechanisms of deformation and damage development to the macroscopic mechanics of fracture, the author provides a valuable guide to the literature which should be invaluable to both professionals and advanced students in this field. Clearly, Riedel's book will remain a principal reference in the field of creep fracture for several decades.

Reviewer: A.S. Argon, Quentin Berg Professor of Mechanical Engineering, Massachusetts Institute of Technology, deals with mechanics and mechanisms of deformation and fracture of engineering solids. □

https://doi.org/10.1557/S0883769400063788 Published online by Cambridge University Press