Thermomechanics of Composites Under High Temperatures

Yu. I. Dimitrienko, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1998, 347 pp., $159.00

This book is dedicated to developing and stimulating study associated with the thermomechanical behavior of composites at *high* temperatures. The italics are significant for distinguishing the behavioral response of materials at normal and elevated temperatures by accounting for irreversible physical and chemical transformations that may occur in the matrix and/or reinforcements at high temperatures (>200°C). It is noted that, at such temperatures, thermo-decomposition and ablation is possible, increasing problem complexity and requiring the consideration of several disciplines, including thermal physics, thermal chemistry, and solid mechanics.

The book consists of 12 chapters and an appendix. The first chapter is introductory and examines the principal sources of high-temperature effects on composites, such as aerodynamic heating. The importance of high temperatures in composite physiochemical transformations accompanied by ablation, i.e., loss of mass, is discussed. Chapters 2 and 3 present a general development of the governing equations of ablative composites at high temperatures. Chapters 4 and 5 focus on studies of the behavior of the basic constituents of composites, that is, the matrix and its reinforcements, at high temperatures. Chapter 4 examines the isotropic behavior of ablative matrices at high temperatures, considering the interrelationship between the micro- and macrocharacteristics of the matrix phases. The effect of high temperatures on reinforcing elements used in matrices, including dispersed particles, short fibers, and continuous fibers, is discussed in Chapter 5. Chapters 6 and 7 analyze the behavior of unidirectional and textile composites subjected to high temperatures, and Chapter 8 discusses the behavior of composites reinforced by dispersed particles and subject to high temperatures. The models presented allow for an evolution of the main material characteristics, including strength, modulus, and ablation rate. Chapters 9 and 10 examine the effects of gradient heating on composites, with Chapter 9 focusing on the phenomena and Chapter 10 examining the linear ablation problem. Chapters 11 and 12 examine the subject of thermal stresses in composite structures, with the former examining the general problem formulation and the latter the evaluation of thermal stresses in thin-walled structural shells. The abbreviated appendix discusses key experimental methods for determining composite material properties under high temperatures, including such parameters as density, heat conductivity, gas permeability, elastic modulus and strength, deformations, and linear ablation rate.

This book appears as a first-time exposition of the methodology associated with modeling the thermomechanical behavior of composites considering physiochemical transformations. The book is well organized, with a logical progression of the topical areas presented. A representative reference list is included at the end of the book, with a strong representation of the Russian literature. A summary of the nomenclature as well as subscripts used is included at the beginning of the text. This book will be a welcome addition to the literature for those scientists and engineers faced with the challenge of designing advanced composite materials for use at high temperatures.

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Errata

Pagination Error

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IN the July 2000 issue of *AIAA Journal*, the printer inadvertently ran pages 1273–1303 out of order. All of the pages appear, but the reader will have to check the actual page numbers when perusing the papers published in the affected section of the journal. We regret the inconvenience caused by this error.