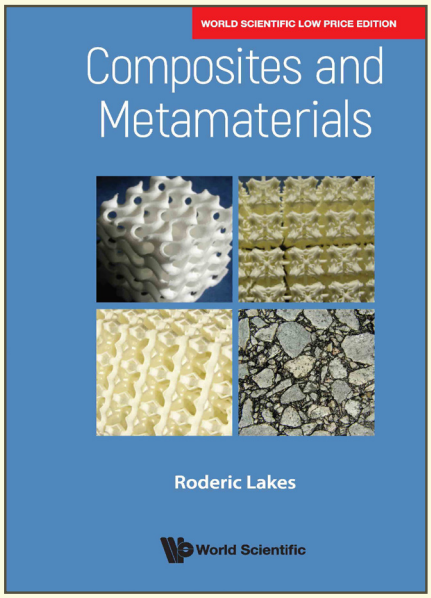
Composites and Metamaterials



By **Roderic Lakes**
(University of Wisconsin-Madison, USA)

ISBN	9798886130171
Extent	280pp
Binding	Paperback
Year	2024
Price	Rs. 1795

ABOUT THE BOOK

This book is an excellent primer for students to learn about physical properties, particularly mechanical properties of heterogeneous and multiphase materials and the cultivation of physical insight. Written by a prominent author who pioneered many of the concepts, this book provides a comprehensive coverage of fundamental and current topics in traditional composites and new heterogeneous materials.

Topics covered include:

- Principles of the mechanics of solid multiphase systems.
- Role of heterogeneity and anisotropy in determining physical properties including elastic, dielectric, and piezoelectric properties.
- Coupled fields; smart materials including piezoelectric materials and thermal actuators.
- Applications in lightweight structures, ultra-strong materials, materials for protection of the body, and materials for the replacement of human tissues.
- Materials with fibrous, lamellar, particulate, and cellular structures.
- Lattice metamaterials. Extreme and unusual physical properties.
- Heterogeneous materials of biological origin.
- Metamaterials and biomimetic and bio-inspired materials.

READERSHIP

This book is intended as a course pack for senior and graduate students to understand physical properties.

CONTENTS

- Introduction
- Structures, Properties and Bounds
- Symmetry and Anisotropy

- Coupled Fields
- Particles, Fibers, Platelets
- Cellular Solids and Lattices
- Biological Material Structural Hierarchy
- Size of Heterogeneity
- Viscoelastic Composites

ABOUT THE AUTHOR

Professor Roderic Lakes is a Distinguished Professor in the Department of Engineering Physics at the University of Wisconsin and is also affiliated with the Department of Materials Science. He has taught courses in composite materials, experimental testing of materials, viscoelastic materials, biomechanics, and biomaterials among others.

Honors include becoming a fellow of the American Association for the Advancement of Science (AAAS) and the American Society of Mechanical Engineers, and several teaching awards. He is the author of other books including *Viscoelastic Materials and of Biomaterials* (2nd and 3rd Edition) with J B Park and is author or co-author of 15 chapters in books and 300 articles in archival journals.

Professor Lakes' research activities have led to the following, some of which were derived from teaching:

- Developed the first 3D materials with a negative Poisson's ratio, in later years called auxetic.
- Developed the first materials with arbitrarily large magnitudes of positive or negative thermal expansion. Zero thermal expansion is also attainable.
- Developed the first extreme materials based on negative stiffness inclusions in composites; developed theoretical framework for elastic chirality, the first experimental measurements of elastic chirality and the first design and making of elastic chiral materials.
- In recent years, materials with reversed or extreme properties have been called metamaterials. Lakes' research interests also include viscoelastic spectroscopy, development of high performance viscoelastic materials and development of high performance hierarchical materials.

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