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. . . Provides guidance on evaluating multifunctional materials

The Physics of Multifunctional Materials

Concepts, Materials, Applications

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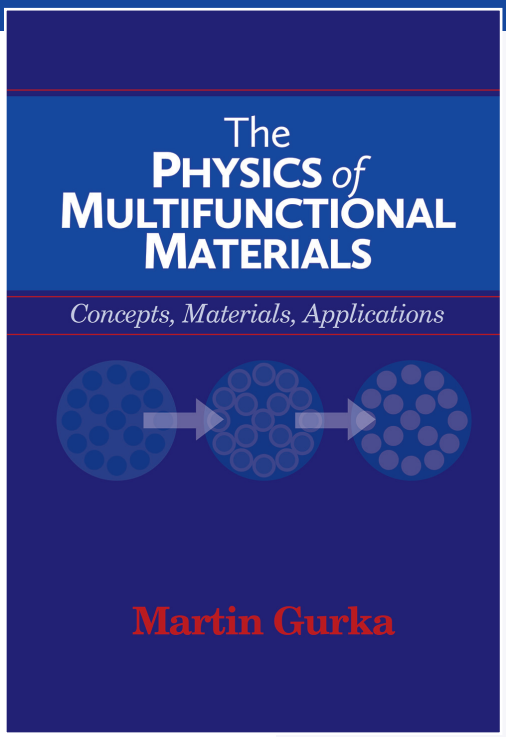

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- **Applies foundational physics and materials science concepts to piezoceramics, shape memory alloys, and switchable fluids**
- **Uses basic scientific measurements to address manufacturing, processing, and modeling**
- **Includes information on multifunctional materials' applications for actuators and sensors**

This book uses basic mechanical, thermodynamic, material science, and electrical concepts from well-known physics to explain the properties and performance of multifunctional materials. With familiar theory and a focus on phase transitions, the text offers a simple, elegant introduction to the design and operation of devices that incorporate piezoceramics, shape memory alloys, electrorheological and magnetorheological fluids. The physics equations and graphical data in this volume form a novel approach to characterizing and assessing smart materials.

From the Preface

"The scope of this book is to explain the physics and materials science underlying multifunctional materials and composites made thereof. The text identifies and elaborates the fundamental principles of ferroelectricity, elastic phase transformation, and energy transfer mechanisms that form the common basis for understanding the functionality, application potential, and limitations of a smart materials system. "While these principles are independent of specific kinds of materials or particular applications, they are explained in the context of a representative material and application. That is, the principles apply to whole groups of materials and can be used to differentiate between them. The present book endeavors to cover the basic physics pertaining to multifunctional materials: from mechanics, electrodynamics, thermodynamics, and condensed matter physics, either as a short summary or as applied to selected examples from the large group of multifunctional materials. Familiar physics principles are thus used as a guide to the nature and design of these materials.

"The book concentrates on three different types of multifunctional materials: piezoceramics, shape-memory alloys, and switchable fluids (electrorheological and magnetorheological fluids). These materials are the best-known commercially available multifunctional materials with the most applications. More interesting in the context of this book is the fact that although the aforementioned examples are all made from very different materials, namely, ceramics, metals, and fluids, respectively, their multifunctionality is based on the same underlying principle—a structural phase transition induced by an external field, either an electrical, magnetic, or thermal field. This is one reason why multifunctional polymeric materials are not discussed. In most cases, polymer multifunctionality relies on mechanisms besides phase transition."

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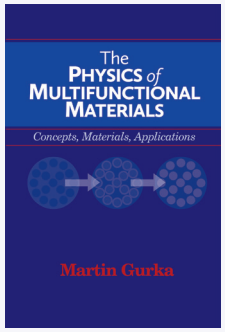

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