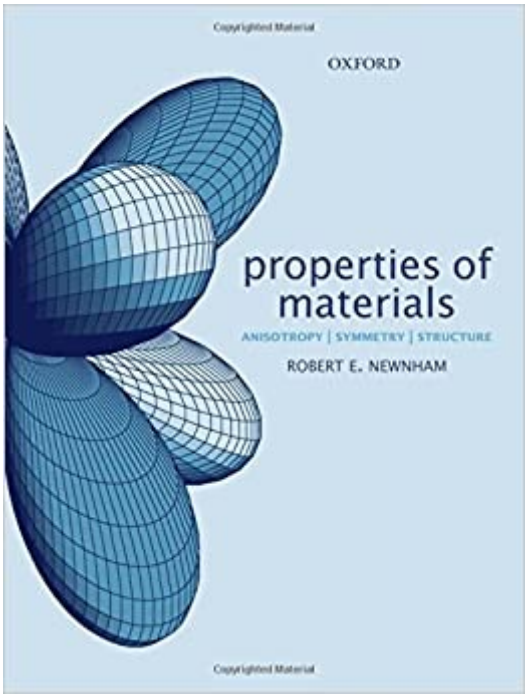
Properties Of Materials: Anisotropy, Symmetry, Structure



Synopsis

Crystals are sometimes called "Flowers of the Mineral Kingdom." In addition to their great beauty, crystals and other textured materials are enormously useful in electronics, optics, acoustics, and many other engineering applications. This richly illustrated text describes the underlying principles of crystal physics and chemistry, covering a wide range of topics, and illustrating numerous applications in many fields of engineering using the most important materials. It has been written at a level suitable for science and engineering students and cab be used for teaching a one- or two-semester course. Tensors, matrices, symmetry, and structure-property relationships form the main subjects of the book. While tensors and matrices provide the mathematical framework for understanding anistropy, on which the physical and chemical properties of crystals and textured materials often depend, atomistic arguments are also needed to qualify the property coefficients in various directions. The atomistic arguments are partly based on symmetry and party on the basic physics and chemistry of materials. After introducing the point groups appropriate for single crystals, textured materials, and ordered magnetic structures, the directional properties of many different materials are described: linear and nonlinear elasticity, piezoelectricity and electrostriction, magnetic phenomena, diffusion and other transport properties, and both primary and secondary ferroic behavior. With crystal optics (its roots in classical mineralogy) having become an important component of the information age, nonlinear optics is described along with the piezo-optics and electro-optics, and analagous linear and nonlinear acoustic wave phenomena. Enantiomorphism, optical activity, and chemical anisotropy are discussed in the final chapters of the book.

Book Information

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Customer Reviews

Gives a great overview into the subject easy to understand even for people who just started getting into this subject covers all the important areas. A highly recommended book! * Michaela Kogler, University of Innsbruck *

Robert E. Newnham is Alcoa Professor of Solid State Science in the Materials Research Laboratory at The Pennsylvania State University, USA.

A must-have if you deal with materials science or condensed matter physics.

It is a great pleasure to be the first person to write a review for the book by Professor Newnham.As a background for those who do not know Prof. Newnham, let me tell you that he is a member of the National Academy of Engineering, and the Ben Frankling Medal Laureate in Electrical Engineering, to name a few of his credentials. What is today known as "piezoelectric composites" is his brainchild, which had an immense impact on modern medical ultrasound and sonar technology.With all that said, off we go to the review.Entropy4Life----------The title of the book is truly a propos to what is covered therein. One cannot help but notice the perfect balance bewteen crystal physics and solid state chemistry throughtout the text. Prof. Newnham’s prose is simple and clear, which makes the book very agreeable to read. All scientific explanations that are presented are "right on the money," to coin a phrase.Older classical texts on crystal physics such as Nye, Banvanghataman, Juretschke, Mason, Voigt, Wooster etc., which are good books to read, do not go beyond providing a phenomenological description of crystal anisotropy using tensors and matrices. On the other hand, classical and widely popular books on crystal chemistry or Solid State Chemistry, such as Jaffe and West, are excessively descriptive and with barely any mathematical treatment of the phenomena of interest.Prof. Newnham, on the other hand, establishes the necessary mathematical and crystallographic foundation in the first 6 chapters of his book with sufficient clarity and depth. He then proceeds to discuss a wide range of topics in the ensuing 26 chapters in a very systematic fashion.In addition to the conventional topics in crystal physics, the book also includes chapters on Nonlinear Phenomena (nonlinear dielectric and elastic response, electrostriction, magnetostriction and electromagnetostriction), Ferroic Crystals, Acoustics, and Nonlinear Optics, which are usually not encountered in classical crystal physics or chemistry texts. Most importantly, every physical phenomena described in the book is masterfully linked to its chemical or structural origin, and structure-property relations are effectively conveyed to the reader.

The discussion of principles and facts are supported with plenty of experimental data to compare and contrast the effects of structure on properties, which helps the reader to develop a "feel" for what is being discussed. Also, the illustrations are carefully chosen, an fully integrated into the discussion. Furthermore, Prof. Newnham also describes the basics of an array of experimental techniques used to determine various properties of crystals, which complements the discussion very well.I believe the book is very accessible to even those who have a modest background in physics and chemistry as the subject is treated with a "from the ground up" approach. One merit of the book that should not go unmentioned here is its pedagogical value. And that, indeed, should not be a surprise to the reader since Prof. Newnham is well-known in the scientific community for his zeal to teaching. Hence, the title of this review: "A Classical Textbook from the Master..."In closing, I am believe that Prof. Newnham's book will most likely become the "Lehrbuch" for the new generation of scientists and enginneers who fancy (or need) to learn applied crystal physics and chemistry. Well...Voldemar Voigt's "Lehrbuch der Kristalphysik" was long overdue for retirement anyway (with all due respect, of course)... :-) I highly recommend it.PS: Did I mention that the price it right as well?----------

Until I stumbled upon this text, I have always found that there is a disconnect in many standard MSE textbooks between structure and properties. Normally students take a course in structure which reviews crystallography topics such as lattices, point groups/symmetry , and x-ray diffraction as well as a separate course in properties(electrical,optical,magnetic,mechanical,etc). However, the connection between the two is rarely secured to give the individual a fundamental understanding of the relation amongst the two. This text, in my opinion solves this problem. Dr. Robert Newnham presents all the needed tools from crystallography and connects them with material properties. The reader will find that he covers a broad range of material type responses e.g. dielectric constant, pyroelectricity, elasticity, piezoelectricity, magnetic phenomena, etc. This book has really helped me think about the implications of engineering periodic structures at the nanoscale level.Searching on the internet, I was sadden to read that Dr. Robert Newnham has passed away. There are a few additions that I think could have been added to this text such as relating structure to electron bandstructures especially of low symmetry crystals. I also agree with Dr. Entropy's review on every point.It would be nice to take a course that has adapted this text.This is a must buy for any MSE personnel.

For anybody who is interested in doing serious materials modeling this book belongs on your book

shelf. As Materials Scientists, we don’t have the luxury to assume materials behavior is isotropic. This book explains how crystal symmetry (or lack thereof) brings about anisotropic material responses to applied stresses, electric fields, composition gradients, etc... I found this book easy to read and helpful when I was studying piezoelectric behavior for an exam.

exact item and fast shipping

I found this book easy to read even my background in physics is not so solid. However, it would be best if the author can use one chapter to describe experimentally how the materials are classified into different crystal classes and how the physical properties are characterized.

Book was in good condition when I received it and was way cheaper than buying it at a book store

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