



Properties of Materials: Anisotropy, Symmetry, Structure

Robert E. Newnham

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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 can 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 anisotropy, 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 partly 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 analogous linear and nonlinear acoustic wave phenomena. Enantiomorphism, optical activity, and chemical anisotropy are discussed in the final chapters of the book.

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