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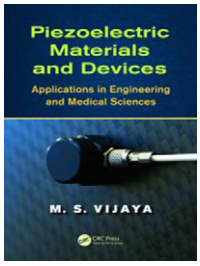
Books and Media



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Piezoelectric materials and devices

Applications in engineering and medical science

The book provides a comprehensive yet simple introduction to the fundamentals and applications of piezoelectric materials which are currently experiencing a second wave of interest due to the growing range of applications in energy harvesting and biomedical devices. It attempts to combine a simple educational approach with several examples of cutting edge applications. The introduction to the Finite Element Modelling (FEM) method as applied to piezoelectric structures is also an advantage of this book.

The book by Prof. M.S. Vijaya is one of the first attempts to combine the very basic principles of piezoelectricity and ferroelectricity with a rather extensive description of cutting edge applications (including those just emerged). The introduction to FEM is helpful as a modern approach to the fabrication of piezoelectric devices. It starts with their modeling using available FEM packages and in addition it contains table data on major piezoelectric materials along with examples of simple calculations of several structures. This makes the book a source of indispensable information for entry level students, application engineers entering the field, technologists working on materials processing, and a broader community wishing to understand the role of piezoelectricity in science and technology. It continues the series of excellent books targeting both fundamentals and applications of piezoelectrics, for example, written by Kenji Uchino (''Piezoelectric Actuators and Ultrasonic Motors'', Springer, 1997) and by Herbert Moulson (''Piezoelectric Transducers and Applications'', Springer, 2004). These books cover both the fundamentals of piezoelectrics and their applications emerged up to early 2000s. The book by M.S. Vijaya fills this gap. The lack of in depth description of the piezoelectric and ferroelectric phenomena in Vijaya's book as compared to other sources published in the last decade is somehow compensated by the extensive referencing to the recent literature and full coverage of recent applications linked to the FEM prototyping that is indispensable for predicting the device performance.

The first chapter is an introduction to dielectric materials and their classification based upon their symmetry. The distinction between electrostrictive (quadratic) and piezoelectric (linear) effects is clearly described. Ferroelectric phenomenon is introduced at the elementary level. The concept of ferroelectric domains and poling necessary to reach the highest piezoelectric coupling are presented.

The second chapter gives a mathematical definition of the piezoelectric effect in the tensor form and provides information on the constitutive equations of piezoelectric effect and piezoelectric coupling for different cases. Further on in Chapter 3 the piezoelectric properties and fabrication methods are described for the several classes of piezoelectric materials: single crystals, ceramics (including thin films), and polymers. A short description of piezoelectric composites is given, too.

Chapters 4 and 5 are the most important in the book and cover engineering and biomedical applications of piezoelectrics starting from the common gas igniters to sophisticated medical imaging devices. The description is simple but instructive and

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includes original references for the interested reader. It links the phenomenological description of piezoelectricity to the figures of merit and device performance. Biological applications of piezo electrics (almost ignored in early literature) are well presented in the book.

In the last Chapter the author provides an entry level descrip tion of FEM tools (ANSYS and PAFEC) as applied for piezoelectrics. Case studies of modeling of representative piezoelectric structures are very instructive and can be used as guidelines for newcomers.

As mentioned above, the book can serve as an excellent intro duction for the students specializing in materials science, elec trical and mechanical engineering, and especially piezoelectric materials. This book is an easy read without prior knowledge on crystal symmetry, thermodynamics or other materials properties. For the advanced readers who might be interested to study piezo electric phenomena in depth, detailed books on ferroelectricity and piezoelectricity would be advised. The full range of applica tions covered in the reference list is a good additional reading for those who are ready to use piezoelectrics in their practice. All in all, the unique combination of simple introduction to piezo electrics combined with an extensive in depth coverage of their applications and overview of modeling tools makes this book a good starting point for students, engineers and technologists, as well as for broad science oriented public.