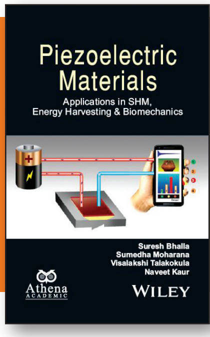


Piezoelectric Materials: Applications in SHM, Energy Harvesting & Biomechanics

Suresh Bhalla, Sumedha Moharana, Visalakshi Talakokula, and Naveet Kaur

Wiley and Athena Academic, 2017
352 pages, $125.00 (e-book $100.99)
ISBN 978-1-119-26509-2

This book, authored by four experts in piezoelectric materials, covers a good range of theoretical and applied topics from the field. It is organized into 11 chapters, and each chapter begins with a brief introduction/background to help readers understand the relevance of the subject. At the end of each chapter, concluding remarks summarize the main points presented. The chapters include an appropriate number of references to the literature, and the majority of figures are informative with good quality.

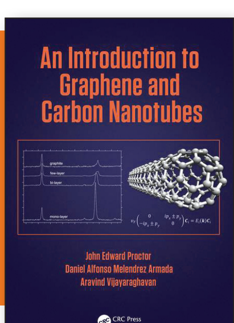
The Introduction presents basic concepts of smart materials and piezoelectric materials and their key applications in structural health monitoring (SHM), piezoelectric energy harvesting (PEH), and biomechanics. The second chapter deals with the following main themes: (1) mathematical formulation of piezoelectricity, (2) selected examples of commercially available piezo-based sensors/actuators for SHM, (3) theoretical and practical description of the electromechanical impedance (EMI) technique, and (4) considerations of one-dimensional and two-dimensional impedance models. These chapters provide a background for students potentially interested in this field but without previous training. However, students must have a good knowledge of mathematics and physics in order to fully understand chapter 2.

Chapters 3–10 are useful as reference material for those working on synthesis and characterization of piezoelectric materials and/or on piezoelectric devices in specialized fields such as biomechanics and energy harvesting. Chapters 3 and 4 address in detail the elasto-dynamic modeling of piezo-transducers for SHM with focus on those based on lead zirconate titanate (PZT). Aspects of fatigue and corrosion damage monitoring are covered in the subsequent three chapters. Only two chapters (8 and 9) are devoted to energy harvesting. They show the analytical models as well as the piezoelectric devices used for this application. The principles of integrated SHM and energy harvesting by PZT patches are also described. Chapter 10 extends discussions of SHM technologies to cover biomedical engineering, emphasizing biomechanics applications. The use of the EMI technique for monitoring the condition of bones and dental implants is presented and discussed.

Chapter 11 looks at the future of piezoelectric materials through the discussion of their emerging applications in SHM, PEH, and biomechanics/biomedical engineering. Three appendices describe the mathematical formulation of the models presented in chapters 2 and 3.

This book provides an excellent introduction to different applications of piezoelectric materials and is a useful reference for upper-level undergraduates who have a background in physics, mathematics, and engineering. It is also suitable for graduate students, engineers, physicists, and researchers interested in this topic, and could be used as a reference guide for professionals working with transducer technologies.

Reviewer: Mariana Amorim Fraga *is a full professor and researcher in the Applied Nanoscience and Plasma Technology Group at Universidade Brasil, Brazil.*



An Introduction to Graphene and Carbon Nanotubes

John Edward Proctor, Daniel Alfonso Melendrez Armada, and Aravind Vijayaraghavan

CRC Press, 2017
302 pages, $89.95 (e-book $80.96)
ISBN 9781498751797

There is continual scientific interest in graphene because of its potential applications in a variety of technologies. This book introduces the structure, properties, synthesis, and applications of graphene and carbon nanotubes (CNTs). The volume has 12 chapters and three appendices.

The first chapter introduces the structure of graphite, graphene, single-walled carbon nanotubes (SWCNTs), and multi-walled carbon nanotubes (MWCNTs). Chapter 2 describes interatomic bonds in carbon-based materials using molecular orbital theory. Hybridized atomic orbitals, σ bonds, and π bonds are used to explain bond lengths, bond energy, and geometry of C–C bonds in different materials. Chapter 3 applies tight-binding theory to explain the electronic properties of graphene. This leads to a discussion of the quantum Hall effect in graphene in chapter 4. Chapter 5 presents the electronic dispersion relation of SWCNTs, semiconducting or metallic nature of a given SWCNT, and curvature effects. Chapter 6 introduces acoustic and optical phonons in graphene and SWCNTs, and chapter 7 covers Raman spectra of graphite, diamond, graphene, and SWCNTs. The mathematical treatment of diffraction using the Laue method is discussed in chapter 8, along with a brief overview of microscopy techniques used to characterize graphene and CNTs.

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