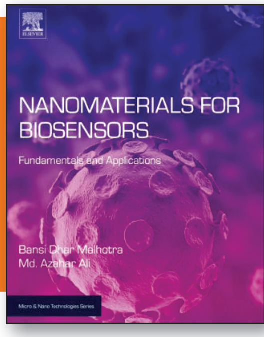


Nanomaterials for Biosensors: Fundamentals and Applications

Bansi Dhar Malhotra and Md. Azahar Ali

Elsevier, 2017
332 pages, $135.00 (e-book $135.00)
ISBN 9780323449236

The subject of nanomaterials for biosensors is generally of great interest to undergraduate and graduate students in chemistry, physics, materials science, and biomedical science. This book, authored by Malhotra and Ali, makes a good effort to explain the basic concepts of biosensors based on different types of nanomaterials.

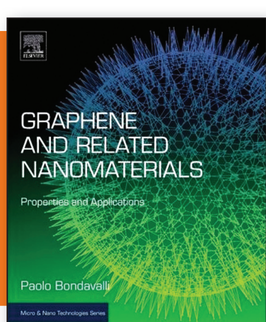
The first chapter is an introduction to the fundamentals and applications of nanomaterials and biosensors. The advantages of the use of engineered nanomaterials in biosensors, such as nanoscale size and compatibility with biological molecules, are discussed. For chapters 2–8, each chapter covers the properties and biosensing applications of a type of nanomaterial. Chapter 2 introduces carbon nanomaterials, such as fullerenes, carbon nanotubes, graphene, and graph-ene oxide, and their use in biosensors for monitoring different biological molecules, such as low-density lipoproteins (LDLs). The functionalization of carbon nanomaterials for biomolecule attachment is explored.

The concepts related to properties that characterize nanostructured metals and metal oxides are presented in chapter 3, with a focus on their use in point-of-care diagnosis and immunosensors. Chapter 4 provides a discussion on the properties of conducting polymers and their applications in biosensors and bioimaging. In chapter 5, the multifunctional properties of hybrid nanocomposites are discussed because of their promise as materials for biomolecular devices, especially for healthcare diagnostics. The issues related to coupling of plasmonic nanostructured materials with fiber-optic technology for the development of biosensors are discussed in chapter 6.

Chapter 7 explores the fundamental properties of different types of nanostructured biomaterials, specifically metallic, ceramic, polymeric, and composite for *in vivo* and *in vitro* biosensors. DNA biosensing principles are discussed in chapter 8. Various techniques for DNA detection and transduction methods are presented. This chapter also includes a description of the development of DNA biosensors and microarray-based devices. Chapter 9 addresses the integration of microfluidics with biosensors and the use of nanomaterials in microfluidic biosensors. An overview of the principles of microfluidics for chemical analysis of biomolecules is presented. Finally, the last chapter of the book discusses future developments in biosensors and their commercialization.

Each chapter ends with a suitable reference list and has a good number of illustrations. However, it contains no didactic exercises. This book is useful for introducing the concepts of nanomaterials-based biosensors and their applications, which is particularly relevant for students seeking knowledge in this field. It is suitable as a textbook for mid- and senior undergraduate level courses devoted to biosensors in materials science, physics, chemistry, and engineering sciences.

***Reviewer: Mariana Amorim Fraga**, professor and researcher, Applied Nanoscience and Plasma Technology Group, Universidade Brasil, Brazil.*



Graphene and Related Nanomaterials: Properties and Applications

Paolo Bondavalli

Elsevier, 2017
192 pages, $150.00
ISBN 9780323481014

This is an outstanding book on graphene and related materials, including carbon nanotubes, graphene oxide (GO), and reduced graphene oxide (R-GO). Four chapters cover the fabrication, fundamental properties, and characterization of carbon-based materials and devices. This book will be useful for researchers working in graphene materials in the applied physics, chemistry, and materials science areas.

Chapter 1 starts with fundamentals of carbon atomic configuration. Fundamental properties and various applications of carbon allotropes such as fullerenes and nanotubes are discussed in detail. Transfer characteristics, band diagrams, and sensor performance of carbon-based devices, such as transistors and sensors, are explained with the help of experimental and simulated data for various input conditions. A brief history about the discovery of graphene is given at the end of the chapter.

The second chapter is dedicated to nonvolatile memory devices based on graphene nanomaterials. Switching behavior, current–voltage (I–V) characteristics, and repeatability during hundreds of cycles of graphene-based devices are discussed in detail, along with the SEM and HRTEM images of those devices. Tables present the results (e.g., switching time, retention time, cyclability) obtained from the various nonvolatile memories built with graphene, GO,

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and R-GO. With the help of schematics, MoS_2/graphene heterostructure memory layout and energy-band diagrams are presented.

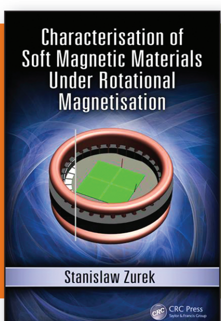
Fabrication and applications of electric double-layer capacitors based on graphene-related materials are presented in the third chapter. Basic physics principles of supercapacitors are discussed with the help of the Helmholtz model and respective diagrams and V-E characteristics. Ragone plots of graphene supercapacitors, SEM and TEM images of various graphite collectors, and images of flexible electrodes are useful for readers to understand the device characteristics and their cross-sectional views. At the end, graphene-based composites for supercapacitors are briefly discussed.

The fourth chapter deals with physical phenomena and industrial interest behind other 2D materials, such as silicon, germanium-based materials, stanene, transition-metal dichalcogenides (TMDs), phosphorene, carbides, and nitrides. The quantum Hall effect and quantum spin Hall effect in 1D systems are explained with magnetic theories. Fabrication of transistors using TMD, their morphology, *I–V* characteristics, and device illustrations are well explained. At the end, various applications (e.g., spintronics, thermoelectric) of these 2D materials are listed.

The fifth chapter discusses the basics of spintronics. Graphene-based spintronic devices, their fabrication methods, and characteristics of spintronic devices are discussed. Main parameters for spin are measured in different materials compared to graphene and are tabulated.

In summary, this is an outstanding book covering many nanodevices based on graphene, TMD, and other 2D materials. Fundamental properties and fabrication methods of recent graphene-based 2D materials are well covered. This book is mainly targeted toward researchers. Recent references are listed at the end of each chapter. There are no solved problems or homework problems provided. I strongly recommend this book to researchers interested in device fabrication based on graphene, carbon-based materials, and other 2D materials.

Reviewer: K. Kamala Bharathi*, SRM Institute of Science and Technology, India.*



Characterisation of Soft Magnetic Materials Under Rotational Magnetisation

Stanislaw Zurek

CRC Press, 2017
596 Pages, $179.95
ISBN 9781138304369

Soft magnetic materials, including electrical steels, soft magnetic composites, and ribbons, play a key role in energy conversion. In particular, electrical steels, which are alloys of iron and up to 6.5 wt% silicon with tiny amounts of other elements, have been widely used for green energy equipment from traction motors to wind turbine generators.

For most of the applications, the materials experience constantly varying magnetic fields in both magnitude and direction. The response of the magnetic materials to the applied magnetic field, and the resultant loss, is one of the major concerns for magnetic device designers. There are many efforts and published papers on rotational power-loss measurement. This book provides a comprehensive review of different measurement techniques of soft magnetic materials.

The first chapter includes a brief introduction to magnetism, magnetic materials, and, most importantly, the loss mechanism. The topics covered in this chapter are broad, and a better understanding may demand a closer look at the references. In chapter 2, principles of four major measurement methods, torque metric, thermometric, field metric, and watt metric, are presented. Chapter 3 covers sensors, including principles and implementation. More importantly, the practical comment sections address the typical problems during measurement and also the problems inherent to the device or the data-processing procedure.

Chapter 4 discusses apparatus for measurements, which forms the core of this book. In addition to the signal excitation and collection issues, sample preparation techniques are also discussed, as the properties of electrical steels are extremely sensitive to processing parameters. Measurement errors are the focus of chapter 5. Both sources of error and methods for error evaluation are introduced. Chapters 6 and 7 discuss measurement equipment and measured results, with illustrations of measurement equipment. It would be beneficial to highlight the pros and cons of the equipment and the linkage between the measured result and the properties of the materials. In chapter 7, some numerical techniques in data processing and approximate analytical methods in rotational loss calculation are included.

In summary, the book focuses on real-life engineering applications. With no worked examples and homework problems, it is not assumed to be a textbook. It is, however, an excellent reference book with detailed explanations of state-of-the-art measurement techniques, equipment, and data-processing skills. More details on specific topics can be found from the references, which are complete and up to date. Overall, the book is well written, and all figures are of high quality. Students or professionals who are working in or planning to work in the field of soft magnetic materials characterization would find it quite instructive. Readers with an engineering undergraduate degree should have no problem comprehending most of the content.

Reviewer: Wanfeng Li*, Research Engineer, Ford Motor Company.*

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