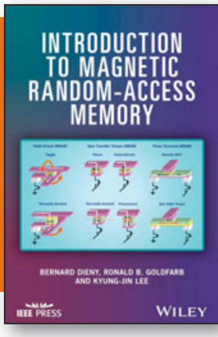


Introduction to Magnetic Random-Access Memory

Bernard Dieny, Ronald B. Goldfarb, and Kyung-Jin Lee

Wiley-IEEE Press, 2016
264 pages, $125.00 (e-book $100.99)
ISBN 978-1-119-00974-0

This is an interesting book that gives a deep introduction to and explanation of the physics behind spintronics and magnetic properties of materials used in magnetic random-access memories (MRAMs). It gathers the theoretical concepts of magnetism along with the technological developments of electronic devices for memory and storage applications. It is mainly intended for graduate students, microelectronics/materials engineers, and researchers working on magnetic memory devices.

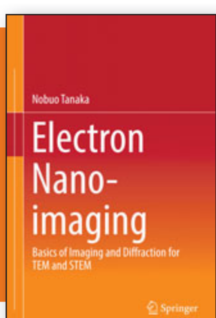
The book is structured in three parts. The first two chapters are focused on spintronic transport phenomena and magnetic materials used for storage and memory devices. Chapter 1 introduces spintronics and the magnetoresistance effect, presenting the quantum formalism required to describe both giant magnetoresistance and tunneling magnetoresistance phenomena. Chapter 2 discusses properties of the materials used in magnetic tunnel junctions for MRAM devices.

The second part provides a more in-depth introduction to the theory of magnetism, how it can be sensed and developed in nanostructured materials, and the main concepts required to understand magnetic storage and memory devices.

The third part, consisting of the last three chapters, is dedicated to nonvolatile magnetic memory devices, covering the evolution, integration, and compatibility with complementary metal oxide semiconductor circuitry, as well as future perspectives beyond MRAM. Chapter 5 presents a historical overview of the evolution of MRAMs and different types of structures used in magnetic nonvolatile memory devices, comparing them in terms of fabrication and operational properties. The different functions that each memory device should address, such as storage, read/write process retention, and endurance, are detailed. Chapter 6 discusses the integration of MRAM focusing on back-end technology. Chapter 7 considers the circuitry challenges of combining these spintronic components with memory and logic circuits.

This is a well-structured book, full of information and with brief introductions, which allows the reader to easily identify the content and purpose of each chapter. It contains many figures but few tables. The bibliography is suitable, although it lacks recent works. It is not sufficient as a textbook because of inadequate problems and homework sets; instead, it is meant as a reference tool for researchers and engineers looking for a working knowledge of magnetic memory devices.

***Reviewer: Joana Vaz Pinto** is an assistant professor at the Universidade Nova de Lisboa, Portugal.*



Electron Nano-Imaging: Basics of Imaging and Diffraction for TEM and STEM

Nobuo Tanaka

Springer, 2017
333 pages, $99.00 (e-book $74.99)
ISBN 978-4-431-56500-0

As a materials scientist who not only uses transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM) for materials characterization, but also teaches classes on electron microscopy, I enjoyed reading this book. It covers a wide range of applications, from basics on electron microscopy and diffraction, to more advanced, newly developed techniques for imaging and diffraction. The book is divided into three parts: Part I covers nano-imaging in TEM mode, Part II covers nano-imaging in STEM mode, and Part III contains a series of appendices with background theory on imaging and diffraction.

The first three chapters focus on basics of imaging and diffraction, with an emphasis on the concepts of imaging in TEM mode compared to an optical (light) microscope, while the appendices have more rigorous math on Fourier transforms and image formation with electromagnetic lenses and the role of aberrations. Chapters 4–7 cover resolution, high-resolution lattice imaging, and the effects of lens aberrations and voltage instabilities.

Chapter 8 describes several advanced imaging techniques, starting with the physics of electron energy-loss spectroscopy and the use of this technique in imaging by energy-filtered TEM. This chapter also describes electron tomography to obtain 3D reconstruction images from a series of images taken from the same area of a sample but at different angles.

Part II describes imaging in STEM mode with a detailed comparison to a scanning electron microscope (SEM). Chapters 9–11 describe image formation in STEM by the scanning of a small spot of the electron beam over an area of the sample. These chapters also present image contrast in STEM and the difference between bright-field STEM and annular dark-field STEM. Chapter 12 presents imaging theory in STEM.