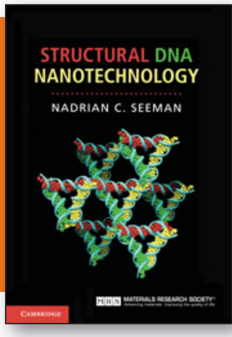


Structural DNA Nanotechnology

Nadrian C. Seeman

Materials Research Society and Cambridge University Press, 2016
266 pages, $52.00 (e-book $52.00)
ISBN 9780521764483

In the interest of transparency, MRS is a co-publisher of this title. However, this review was requested and reviewed by an independent Book Review Board.

This book provides an authoritative introduction to the nascent field of structural DNA nanotechnology. It was written by the founder of the field, Ned Seeman of New York University. The book was written mostly during a sabbatical that Seeman took in 2010 and was updated in 2014 prior to being published. It reflects the author's multi-decade experience and pioneering contributions to the field of structural DNA nanotechnology. It also summarizes important developments in this field up to 2014. The book provides a comprehensive overview of this field with 14 chapters covering a wide range of topics, from history to motif design, structural characterization, experimental techniques, devices, and computing, as well as the use of DNA as templates for organizing other functional materials.

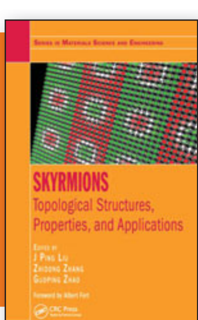
Chapter 1 describes the origins and a brief history of the field of structural DNA nanotechnology, and Chapters 2–7 focus on DNA motifs: various intricate, beautiful, and mostly two-dimensional (2D) DNA structures. Chapter 2 outlines basic principles of DNA nanostructure design, including nucleic acid hybridization, synthesis of desired DNA sequences, and design of branched DNA molecules. Chapter 3 discusses various routes to designing DNA motifs for use as the basis to make objects, lattices, and devices. Chapter 4 describes design examples of DNA motifs using single-stranded DNA, such as knots, Borromean rings, and 2D arrays of DNA junctions. Chapter 5 describes experimental techniques to synthesize and characterize DNA motifs and structures. Chapter 6 is a historical perspective on searching for robust DNA motifs. Chapter 7 is devoted to designing and building larger multi-component constructs by combining different DNA motifs.

Chapters 8–13 address functions of unique DNA structures, including nanomechanics, motions, self-replication, and computing. Chapter 8 discusses DNA structures as nanomechanical devices, where all DNA molecules move in unison at the macroscopic level. Chapter 9 is devoted to the increasingly popular DNA origami and the related DNA bricks. Chapter 10 deals with combining DNA structures with motion, including a discussion of a DNA molecular assembly line. Chapter 11 is dedicated to DNA self-replicating systems. Chapter 12 explores the intriguing possibility of computing with DNA. Chapter 13 summarizes other exotic DNA structures as well as nanostructures made of RNA.

Chapter 14 deals with using DNA as a template to organize other materials and possibly impart functions not possible with other methods. Research on functions and applications of unique DNA structures is at an early stage and has become an increasingly active area of intellectual pursuit and technology development in recent years.

The rapid recent advances in DNA nanotechnology, particularly in building functional 3D structures, devices, and systems with DNA nanotechnology, are a testament of the need for authoritative books like this one. This book features more than 200 full-color illustrations and hundreds of authoritative references, and can serve as a textbook for graduate students. It is well written and easy to follow. It is a must-have book for those who plan to work in the field of DNA nanotechnology. It is also a useful reference book for researchers and graduate students interested in nanoscience, nanotechnology, nanofabrication, nanomedicine, and related fields.

***Reviewer: Qinghuang Lin** of IBM Thomas J. Watson Research Center, USA.*



Skyrmions: Topological Structures, Properties, and Applications

J. Ping Liu, Zhidong Zhang, and Guoping Zhao, Editors

CRC Press, 2016
502 Pages, $175.96 (e-book $153.97)
ISBN 9781498753883

Physicist Tony Skyrme introduced a topological feature called a skyrmion more than 50 years ago. Recently, skyrmions have drawn a great deal of new attention, not only for the related topology and physics, but also for the potential applications of skyrmions in advanced technology (i.e., high-capacity information storage). Research activities on skyrmions have been booming over the past few years, but there have been no books providing a comprehensive review of the research, until this publication. To my knowledge, this is the first book that covers the concepts and features of magnetic skyrmions in such a systematic and comprehensive manner.

The foreword is written by Nobel laureate Albert Fert. The book consists

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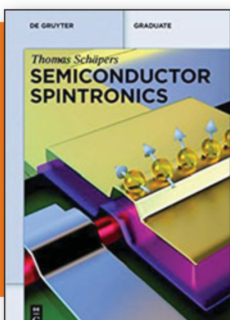
of 14 chapters, with a total of more than 40 contributing authors.

Chapter 1 introduces the general topology of skyrmions. Chapter 2 describes experimental approaches for magnetic domain observations from conventional methods to updated techniques, with a focus on currently adopted observation techniques for skyrmion investigations (including neutron scattering and Lorentz transmission electron microscopy), as well as the related theoretical issues (including the stability of magnetic skyrmions). Chapters 3–7 introduce several other experimental investigations of magnetic skyrmions through the use of techniques, including resonant x-ray scattering, Kerr microscopy, magnetic force microscopy, photoemission electron microscopy, scanning electron microscopy, and spin-polarized electron microscopy. Chapters 8–10 discuss the dynamics of magnetic skyrmions, including field-driven motion, dynamical creation and distortion, and resonant excitation. Chapters 11–14 review the potential applications of magnetic skyrmions.

The figures and tables are adequate, and the references are up to date. The book does not include examples or problem sets. This publication is suitable for readers who are interested in condensed-matter physics, especially magnetism and electronics, both at an undergraduate and postgraduate level. It also can provide good guidance to those starting research on magnetic skyrmions.

Reviewer: Mingzhong Wu *of the Department of Physics, Colorado State University, USA.*



Semiconductor Spintronics

Thomas Schäpers

De Gruyter, 2016
354 pages, $84.00 (e-book $67.00)
ISBN 978-3110361674

This book's clear physics diagrams and theoretical models on magnetic semiconductors and spintronics are impressive. It contains almost all of the new findings on spin-related carriers in different dimensionalities as well as quantum descriptions. It includes a comprehensive discussion on spin-related physical phenomena, their quantum expressions, and future applications, which will be very helpful for graduate students and those beginning research in this field. It can work as a textbook on spintronics for those majoring in condensed-matter physics, as spin physics becomes more important in the field. The exercises listed in each chapter are well presented and helpful. This book will also help expand the concepts of semiconductor spintronics to more people and facilitate more research on new spin-related concepts and devices.

After the introduction to the book in chapter 1, chapter 2 focuses on low-dimensional semiconductor structures. Chapter 3 discusses magnetism in solids, and chapter 4 covers diluted magnetic semiconductors. Chapter 5 reviews magnetic electrodes. Chapter 6 focuses on spin injection; chapter 7 highlights the spin transistor; chapter 8 discusses spin interference; and chapter 9 covers the spin Hall effect. Chapter 10 reviews the quantum spin Hall effect. Chapter 11 describes topological insulators, and chapter 12 discusses quantum computation with electron spins.

Although this book is satisfactory, there are two areas that were omitted. It would have been useful for the book to cover spin-polarized excitations. In this rapidly growing field of research, spin-related carriers are not the only topic that should be covered. Optical techniques remain one of the most important tools to study magnetic semiconductors, but spin-related optical detection and application were not discussed. Perhaps these topics should belong to discussions of spin excitonics on spin photonics. Nonetheless, spin-related exciton and spin-polarized optical behaviors, though having fewer publications on these topics, are also important both in concepts and applications. For example, the excitonic magnetic polaron and its extensions in polarized luminescence, photo-induced ferromagnetism in quantum dots or nanostructures, and spontaneous spin optical orientations and coherent optical behaviors, and possibly the collective magnetic exciton condensation are important.

Additionally, according to recent literature, more examples of ferromagnetic semiconductors have been found in non-doped compounds, whose existence may add some complexity in spintronic materials because defects may also find applications in future spintronic devices. A more explicit discussion of this in chapter 4 would have helped provide a more complete description of semiconductor spintronics. If the author plans a second edition, it would be useful to add some sections or information on the above subjects.

Although the book could be enhanced with the additions discussed previously, this is a good book for graduate students in solid-state physics and semiconductor devices.

Reviewer: Bingsuo Zou *of the Beijing Institute of Technology, China.*

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