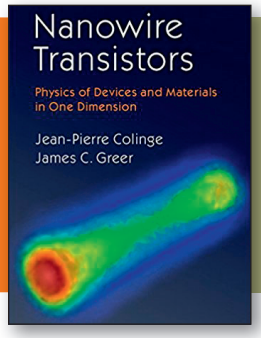


Nanowire Transistors: Physics of Devices and Materials in One Dimension

Jean-Pierre Colinge and James C. Greer

Cambridge University Press, 2016
265 pages, $84.99 (e-book $68.00)
ISBN 9781107052406

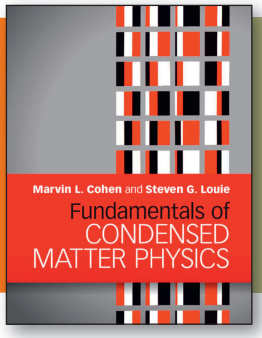
This is a very interesting and advanced book that gives a deep introduction to and explanation of the physics behind nanowire transistors, from the conceptual quantum models to the understanding of the charge-transport properties within one-dimensional (1D) nanostructured materials. It is well written, organized, and self-explanatory, and can be used as a reference by those who wish to enter into this field of nanowire and nanostructure-based electronics. The book has many up-to-date references and clear and precise text with plenty of figures and diagrams, and therefore is a fundamental resource.

It is divided into seven chapters. The first three chapters introduce the use of nanowires as the semiconductor channels in a transistor, while the last four chapters give deep insight into the physical formalism that rules the electronic structure and charge transport in low-dimensional materials, such as nanowires.

Chapter 1 gives a brief introduction to transistors and the consequences and limits of scaling down devices in order to achieve higher density electronics. Chapter 2 focuses on new approaches and architectures for transistors, namely multigate configurations and the use of nanowires as a channel active layer. The synthesis of nanowires and the fabrication of nanowire transistors are presented in chapter 3, focusing mainly on silicon-based nanowires. Top-down and bottom-up silicon nanowire growth methodologies are discussed and correlated to the mechanical properties of the channel achieved. Chapter 4 introduces quantum mechanics in a very simple and straightforward manner in order to explain and deduce fundamental relations related to electronic band structure and density of states in 1D structures. This chapter can be used as a reference for the subsequent chapters. The electronic structure from bulk materials to low-dimensional material properties is discussed in chapter 5, where both experimental and theoretical approaches are presented. Chapter 6 discusses the charge-transport models in 1D nanostructures. Chapter 7 discusses some applications and the performance of nanowires in circuits, memory-based devices, and sensors.

This is a well-organized book wherein the preceding chapters are used as the basis for understanding the following ones. Each chapter starts with a simple introduction and has a final summary where the main conclusions of the chapter are presented, and further reading is proposed for those who wish to go deeper in any covered topic. The book is suitable for graduate researchers in materials science and semiconductor devices as well as engineers who want deeper insight into the explanation of nanowire-based devices. It could be used as a supplementary book in higher grade studies but not as the main textbook of a course, as it contains no study/homework problems.

***Reviewer: Joana Vaz Pinto** of the Universidade Nova de Lisboa, Portugal.*



Fundamentals of Condensed Matter Physics

Marvin L. Cohen and Steven G. Louie

Cambridge University Press, 2016
460 pages, $84.99 (e-book $68.00)
ISBN 9780521513319

This graduate-level textbook on condensed-matter physics is written by two leading luminaries in this field. The volume draws its material from the graduate course in condensed matter physics that has been offered by the authors for several decades at the University of California, Berkeley. Cohen and Louie do an admirable job of guiding the reader gradually from elementary concepts to advanced topics. The book is divided into four main parts that have four chapters each.

In part I, chapter 1 presents models of solids in terms of interacting atoms, which is appropriate for the ground state, and excitations to describe collective effects. Chapter 2 deals with the properties of electrons in crystalline materials. The authors introduce the Born–Oppenheimer approximation and then proceed to the periodic potential approximation. Chapter 3 discusses energy bands in materials and covers concepts from the free-electron model to the tight-binding model and periodic boundary conditions. Chapter 4 starts with fixed atomic cores and introduces lattice vibrations, phonons, and the concept of density of states.

Part II presents electron dynamics and the response of materials to external probes. Chapter 5 covers the effective Hamiltonian approximation and the motion of the electron under a perturbation, such as an external field. The discussion moves to many-electron interactions and the exchange-correlation energy in chapter 6, the widely used density functional theory (DFT) in chapter 7, and the dielectric response function in chapter 8.

Part III begins with a discussion of the response of materials to photons in

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