chapter 9. Chapter 10 details electron–phonon interactions in different materials and introduces the polaron. Chapter 11 presents electron dynamics in a magnetic field, and chapter 12 discusses electrical and thermal transport in materials.

Part IV takes the reader further into many-body effects, superconductivity, and nanoscale materials. The authors introduce Feynman diagrams and many-body perturbation theory in chapter 13, theories of superconductivity in chapter 14, magnetism in chapter 15, and low-dimensional systems in chapter 16.

The first two parts are required reading for the beginner planning to perform DFT calculations. The advanced student interested in conducting research in condensed-matter physics will benefit from continuing on to the last two parts. The narrative is aided by appropriate equations and detailed figures. References at the end of the book direct the reader to relevant books and review articles for each chapter. The authors pre-sent the underlying mathematics elegantly, which makes the textbook quite readable for those with a good mathematical background. Students lacking a firm footing in math will find the terrain rough after chapter 1. This book covers new ground by explaining Feynman diagrams and by making a foray into the low-dimensional world of carbon nanotubes and graphene nanostructures. It fills the need for a rigorous graduate-level textbook, and is a required addition to the bookshelf of every condensed-matter physicist.

***Reviewer: Ram Devanathan** is Technical Group Manager of the Reactor Materials and Mechanical Design Group, Pacific Northwest National Laboratory, USA.*

Two-Dimensional Transition-Metal Dichalcogenides

Alexander V. Kolobov and Junji Tominaga

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Two-dimensional (2D) materials are among the advanced materials that have currently gained a lot of research interest. Transition-metal dichalcogenides (TMDCs) are 2D semiconducting materials that find applications in electronics and optoelectronic devices. Two-dimensional-TMDCs are often referred to as "next-generation graphene," with interesting properties due to their unique band structures in the monolayer. This book provides a thorough description of 2D-TMDCs in a reader-friendly manner.

Chapter 1 provides an introduction to the composition of TMDCs. Chapter 2 discusses the chemistry of transition-metal elements and chalcogenides in TMDCs. Chapter 3 describes the properties of bulk (3D) TMDCs, including their crystal structures and the associated group theory, electronic structures, magnetic properties, and optical properties as revealed by absorption, Raman, and infrared spectroscopy. The pressure-induced transformation of TMDCs is also summarized.

In chapter 4 and onward, the focus is on 2D-TMDCs. Chapter 4 introduces the top-down and bottom-up approaches to form 2D-TMDCs, as well as the materials transfer and analysis techniques. Chapter 5 focuses on the structural analysis of TMDC phases (1T [tetragonal] and 2H [hexagonal]) and their phase transitions, defects, grain boundaries, and doping. The chapter describes other TMDC nanostructures, including TMDC nanotubes, nanoribbons, and quantum dots.

Chapters 6 to 12 provide detailed descriptions of various properties of 2D-TMDCs. Chapter 6 reviews theoretical aspects of the electronic band structure, the indirect-to-direct gap transition, and bandgap tuning. This is followed by experimental evidence such as photoluminescence (PL), photocurrent, scanning tunneling spectroscopy, and angle-resolved photoemission spectroscopy. Chapter 7 discusses the symmetry structures in odd and even layers of TMDCs and their characterization by Raman spectroscopy. Chapter 8 focuses on luminescence in 2D-TMDCs, especially PL spectroscopy. Chapter 9 continues discussion of exciton behaviors and dynamics in 2D-TMDCs and their heterostructures. Chapter 10 discusses magnetic properties due to edges, defects, dislocations, grain boundaries, and doping. Chapter 11 discusses "valleytronics" in 2D-TMDCs in view of the strong coupling of the spin and valley indices. Chapter 12 summarizes miscellaneous topics in 2D-TMDCs that warrant further investigation, including second-harmonic generation, piezoelectric effects, quantum spin Hall effect, Burstein–Moss effect, polaritons, and superconductivity.

Chapter 13 describes heterostructures of 2D-TMDCs, in particular, the vertically stacked heterostructures. The lateral heterostructures and TMDC/2D heterostructures are also mentioned. Chapter 14 highlights applications of 2D-TMDCs, including transistors, integrated circuits, optoelectronic devices, nanoelectromechanical systems, catalysis, energy, and biomedical devices. Chapter 15 provides a list of up-to-date publications on the book's covered topics. Finally, Chapter 16 speculates on the future of 2D-TMDCs.

The book provides a comprehensive introduction to and review of almost every aspect of TMDCs. There are a few books about TMDCs and 2D-TMDCs, but this book is more comprehensive and covers almost every aspect of the materials, therefore, this can be treated as the encyclopedia of TMDCs and suitable as a textbook for graduate students. It is also a good reference for scientists and engineers who are interested in TMDCs.

***Reviewers: Mingxiao Ye** and **Yoke Khin Yap** of Michigan Technological University, USA.*