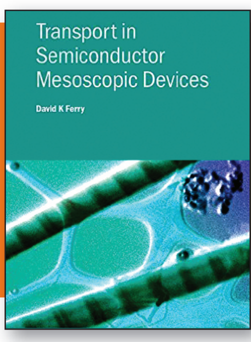
Chapter 2 describes linear elastic-fracture mechanics, its underlying theoretical basis, the stress intensity factor, and the modes that are most frequently considered in the literature (opening, sliding, and shearing modes). The analytical equations delineating the spatial distribution of the normal and shear stress fields surrounding the crack tip are the subject of chapter 3. Chapter 4 treats the impact of the crack opening displacement on the stress. Chapter 5 discusses calculation of the stress intensity factors for different modes and geometries by both analytical expressions and numerical techniques. Chapter 6 covers treatment of cases in which the applied stress and sample geometry have a combination of modes (i.e., mixed modes). Crack growth rates under fatigue, when the specimen is cyclically subjected to low stresses, are predicted in equations given in chapter 7. Chapter 8 covers elastic-plastic fracture mechanics, which has extended the original scope of fracture mechanics to predict the performance of metals. Chapter 9 describes the experimental methods for measuring the key material properties, such as the plane strain fracture toughness, the crack opening displacement, and the κ-resistance curve.

This book is well designed for a broad survey course on fracture mechanics. Each chapter contains many worked example problems and a good selection of homework problems with answers. A solution manual is available that includes images that make the major concepts clear, and there are many references to the original sources for more in-depth coverage. This book is a good introduction to fracture mechanics and is suitable for upper-level undergraduates or first-year graduate students.

***Reviewer: J.H. Edgar** of the Department of Chemical Engineering, Kansas State University, USA.*



Transport in Semiconductor Mesoscopic Devices

David K. Ferry

IOP Publishing, 2015

316 pages, $91.72

(Kindle edition with audio/video $137.52)

ISBN 978-0-7503-1102-1

David K. Ferry, from Arizona State University, is an expert in quantum effects, including charge-carrier transport, in semiconductor devices. He is the author/co-author of several well-regarded books and numerous articles in peer-reviewed journals in this area. In this book, Ferry concentrates on elements of transport associated with "mesoscopic devices," which he defines as devices in which "the critical dimensions of the structure are comparable to the corresponding de Broglie wavelength of the electrons." This book was written primarily as a textbook for first-year graduate students on the basis of Ferry's course notes developed over several years.

The material is organized into 10 chapters. The first chapter introduces fundamental concepts in semiconductor physics associated with nanoscale materials and devices, including a short discussion of nanofabrication techniques. The second chapter focuses on wires and channels and uses the quantum point contact as a tool to discuss concepts such as the density of states, the Landauer transport formalism, scattering matrices, and Green's function approaches. The Aharonov–Bohm effect in mesoscopic structures formed in semiconductor device materials is described in the third chapter. Chapter 4 covers carbon materials, including graphene and carbon nanotubes, as well as topological insulators and chalcogenides. Chapter 5 covers localization and conductance fluctuations and includes a short discussion of disorder and the differences between weak and strong localization, which is based on an approach developed by P.W. Anderson. The chapter concludes with discussions of correlation functions and phase coherence times. Chapter 6 covers three effects in which the conductance is affected by the presence of a magnetic field: the Shubnikov–de Haas effect, the quantum Hall effect, and the fractional quantum Hall effect. The Buttiker–Landauer approach is used to illuminate the latter two effects. Chapter 7 covers spin transport processes, including spin Hall effects, spin injection, spin currents in nanowires, and spin relaxation. Chapter 8 covers transport processes that involve tunneling effects, including Coulomb blockade, single electron structures, double quantum dot structures, quantum dots and qubits, and resonant tunneling diodes. Chapter 9 covers "open" quantum dots in which "the interior dot region is coupled to the reservoirs by means of waveguide leads." The chapter begins with a discussion of conductance fluctuations from magnetotransport, gate-induced voltage fluctuations, and phase-breaking (coherence) processes. This leads to a discussion of pointer states, pointer state statistics, and hybrid states. Chapter 10 covers hot-carrier effects, including energy loss rates and energy relaxation times.

Each chapter includes dozens of references, which the reader will find very helpful for further studies of the covered topics. This is a very good book that will be suitable for classes of well-prepared, first-year graduate students in this field of study. The book will also be useful to researchers as an introduction to the subject. Finally, the book may also be suitable for advanced undergraduates who have a strong background in quantum mechanics and semiconductor physics.

***Reviewer: Steven C. Moss** is a senior scientist in the Electronics & Photonics Laboratory at The Aerospace Corporation in Los Angeles, Calif., USA.*

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