tors differ from other solids such as metals (conductors) and insulators (nonconductors) and how they came to be recognized as a separate class of materials. In fact, probably the best thing about *Getting to Know Semiconductors* is the historical section, sweeping from ancient Greece to the 1947 invention of the transistor (and exposing Russian contributions to the science of semiconductors more than is customary in the "West"). Here and elsewhere in the book, we see the paramount importance of impurities, and we learn that the development of semiconductors depends as much on understanding purification and growth as it does on generating purely electronic ideas.

Nearly a third of the book is devoted to simple semiconductor devices, though generally not the ones involved in the radical changes in computation and telecommunication. The thermistor (a semiconductor thermometer), the strain gauge, the photodetector and Hall effect and Gunn effect devices are all discussed. These sections amplify our understanding of the fundamental properties gained from earlier chapters of the book.

I was disappointed to find no mention of the principles of operation of any transistor, and some readers will be offended by the occasional descent into cuteness. For example, electrons and holes are "heroes," and in a final section we are told that the Bay of Semiconductors is connected via the Sea of Solid-State Physics to the large and stormy Ocean of Science.

But all in all, *Getting to Know Semiconductors* is a good little book that can bring you a solid understanding of the advances in semiconductor physics up to the middle of the 20th century. With that understanding you can perhaps look at today's efforts and appreciate the variety of talents required to keep semiconductors moving forward.

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Charge Exchange and the Theory of Ion–Atom Collisions

B. H. Bransden and M. R. C. McDowell
Clarendon (Oxford U. P.), New York, 1992. 474 pp. $125.00 hc ISBN 0-19-852020-4

Rearrangement collisions involve the transfer or exchange of neutral or charged particles between the initial reactants and the final products in a collision. They occur in a wide variety of applications in atomic, molecular and chemical physics. Examples of rearrangement collisions at thermal energies are hydrogen-atom transfer reactions in the upper atmosphere. At intermediate and relativistic energies, rearrangement collisions occur in an extensive range of ion–ion and ion–atom collisions from inertial confinement fusion to heavy-ion collisions.

The theoretical description of a collision A + B → C + D, which involves rearranging the electrons (and possibly the nuclei) of the initial reactants (A and B) into the products (C and D), requires the resolution of two fundamental questions. First is how to characterize, and choose the coordinates for, the Hamiltonians H_{AB} and H_{CD} of the reactant and product channels, respectively. Second is whether to use the quantum or semiclassical representation for the wavefunction of the complex formed during the collision. To answer both questions requires physical insight into the mechanisms involved in the transfer of charge, as well as a balancing of accuracy with computational practicality.

In the past 25 years advances in computer architecture and software design have led to a vast increase in our theoretical understanding of the quantum chemical properties of a wide range of isolated, static neutral and ionic systems. We also understand better the dynamical cross sections for excitation, ionization and charge exchange in such systems in atomic, molecular and chemical physics. However, a need has arisen in the literature of charge exchange for a global view of all the extant theories, quantum, semiclassical and classical, their interrelationships and ranges of applicability.

This need is met with the timely publication of *Charge Exchange and the Theory of Ion–Atom Collisions* by Brian H. Bransden and M. R. Coulter McDowell. Both authors are well-known authorities in atomic and molecular scattering theory and have been active in both heavy-particle and electron scattering research since the 1950s. As the authors point out in the preface, the book can be considered a replacement for *Introduction to the Theory of Ion–Atom Collisions* by McDowell and John P. Coleman (North-Holland, New York, 1970), which has been out of print for many years. The earlier volume, with its fine exposition of classical and semiclassical scattering and detailed treatment of Coulomb scattering, has become a classic. It is a well-thumbed-through book in my own library. The present volume is a fitting successor to the earlier work and a lasting monument to McDowell, who passed away on 13 June 1993.

A particular strength of *Charge Exchange and the Theory of Ion–Atom Collision* is the fine explanation of the physical ideas motivating the coordinate systems used in theoretical models of charge-exchange reactions. Another strong point is the comprehensive discussion of the various systems of coupled equations that result from different ways of representing the system's wavefunction. Also valuable is the detailed treatment of boundary conditions in Coulomb scattering and the role that continuum states play in charge-exchange reactions. While I lament the omission of much of the older book's material on classical scattering, the deeper understanding afforded by the unified approach of Bransden and McDowell is certainly a signal addition to the literature and will give readers a road map to follow in answering the two fundamental questions posed above.

As befits a volume in the *International Series of Monographs on Physics* published by Clarendon Press, the present book is free of major typographical errors. However, because of the high cost of the hardcover edition I would have preferred a paperback edition for the use of graduate students.

In conclusion, *Charge Exchange and the Theory of Ion–Atom Collisions* will be a valuable addition to the libraries of theorists active in heavy-particle and electron scattering in atomic and molecular physics.

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Materials Fundamentals of Molecular Beam Epitaxy

Jeffrey Y. Tsao
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Some of the most elegant experimental solid-state physics explored in the last 20 years—from the integral and fractional quantum Hall effects to lower-dimensional systems, such as quantum wells, wires and dots—has been enabled by the discovery and seemingly unending refinement of molecular beam epitaxy. MBE's ability to control the growth of layered semiconductor structures on the atomic scale has allowed its practitioners to create the thin film structures required for these elegant experiments with unparalleled precision. At the same time, progress in semiconductor physics has spawned a number of unique semiconductor devices, such as the high electron mobility transistor and the quantum well laser, making MBE an important production technology in high-performance devices. Yet even for those intimately familiar with the details of the exciting physics that these structures explore, the MBE growth process itself remains surprisingly mysterious and inaccessible. *Materials Fundamentals of Molecular Beam Epitaxy* by Jeff Tsao