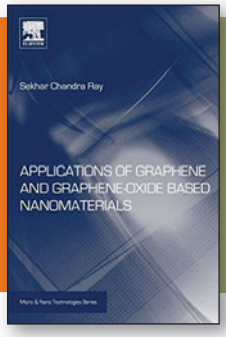


Applications of Graphene and Graphene-Oxide Based Nanomaterials

Sekhar Chandra Ray

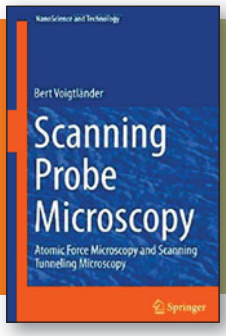
Elsevier, 2015
92 pages, $49.95
ISBN 978-0-323-37521-4

This book falls into Elsevier's Micro and Nano Technologies series. Graphene belongs to an outstanding new class of 2D materials that has opened up new avenues into low-dimensional physics and chemistry. Graphene's high mechanical strength, large surface area, and superior electrical and thermal conductivities have opened up avenues for new devices in a variety of applications, such as electronics and optoelectronics. The progress in this field is exceptionally fast, making headway for new developments. A number of books have been published at an advanced level and are available in the market to satisfy the experts. However, very few books on graphene address the needs of beginners. In this context, the present book is a small-sized edition on graphene written in three chapters with the following coverage.

Chapter 1 is devoted to the application and uses of graphene, with textual material of 31 pages and references running to 7.5 pages. Chapter 2 describes applications and uses of graphene oxide and reduced graphene oxide, with 17 pages and 2.5 pages of references. Chapter 3 is on graphene-based carbon nanoparticles for bioimaging applications, with 22 textual pages and 3.5 pages of references. The first two chapters are written by the author of the book, and the third is co-written with Nikhil R. Jana. The book offers short reviews of a variety of applications such as hydrogen storage, batteries, transparent conductors, flexible electronics, spintronics, ballistic transistors, fuel cells, and bioimaging.

The materials for the chapters are taken from publications in scientific journals and are very useful. In books aimed at describing historical developments and orienting the reader toward the progress of technology in the new and fast-emerging field of graphene, it is common for the author to use a non-scientific language; this book is no exception. The book is good reading material for researchers in the area of graphene who wish to know the developments that have taken place. While this book has limitations in regard to giving the basics along with supporting theory for undergraduate students, it will, however, serve as a useful tool for students seeking knowledge on the applications of graphene.

Reviewer: K.S.V. Santhanam *is a professor in the School of Chemistry and Materials Science at the Rochester Institute of Technology, USA.*



Scanning Probe Microscopy: Atomic Force Microscopy and Scanning Tunneling Microscopy

Bert Voigtländer

Springer-Verlag, 2015
382 pages, $179.00 (e-book $139.00)
ISBN 978-3-662-45240-0

Considering the number of excellent books that have been written to date on this topic, one may ask what another book on scanning probe microscopy (SPM) fundamentals can add to the existing texts. The answer lies in the extent of this burgeoning field. No single work is likely to cover it all, but a good book should describe the relevant topics. Indeed, this volume is not simply a rehash of existing books with some recent developments. It is a nice blend of serious and in-depth presentations of many of the basic fundamentals of the technique, written—in Voigtländer's words—in an "easily digestible manner."

The book begins with a brief introduction, and then plunges into topics (24 chapters) necessary to understand how SPM really works, including in-depth discussions of very technical matters, such as characteristics of operational amplifiers and piezoelectric materials as well as an entire section on noise. Purely technical topics cover about one-third of the content. On the other hand, there is a more fundamental development of tunneling theory and an extended description of the mechanics governing different oscillating modes of atomic force microscopy. In order to make difficult concepts accessible, important and useful equations are developed clearly, with step-by-step explanations. Each chapter starts with a short introduction, and ends with a ½–1 page bulleted summary of the key points. In addition to the topics mentioned previously, there are chapters on artifacts, image analysis, and manipulation, and a few SPM applications such as contact potential measurements, manipulation at the atomic scale, mechanical characterization, and surface spectroscopy. Where necessary, brief discussions on related topics such as surface states and electrostatics are inserted. This is definitely not a "how to" book, and certainly not an exhaustive treatment of SPM: for instance, the vital practical topic of image processing is treated in a very cursory way, and data

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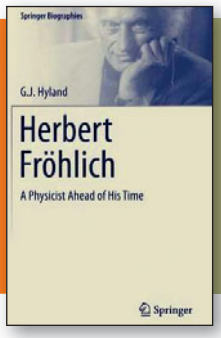
analysis is limited to one page discussing line profiles. SPM lithography is mentioned only in the context of esoteric single-atom placement studies.

The 70 references given are very scant for a book of this scope, but Voigtländer has adapted the approach that original works are only cited where they add something to his own lucid treatment. Rather than supply an exhaustive accounting of the varied applications of SPM, the book attempts to provide a technical, theoretical, and conceptual framework to understand how SPM works and what can be done with it so that a reader wishing to further learn about newer topics will have the basis to do so. This book could thus serve as a useful reference and textbook for anyone desiring an advanced introduction to the fascinating world of SPM.

Reviewer: Sidney Cohen *of the Weizmann Institute of Science, Israel.*



Herbert Fröhlich: A Physicist Ahead of His Time
G.J. Hyland
Springer, 2015
263 pages, $89.99 (e-book $69.99)
ISBN 978-3-319-14850-2

This authoritative biography of Herbert Fröhlich (1905–1991), a well-known theoretical physicist, paints an intimate portrait of a pioneering scientist who made seminal contributions to condensed-matter physics and left his mark on other domains, such as biology, over a 60-year career. From his vantage point as the last graduate student of this eminent physicist, Hyland has produced an account that weaves the personal experiences and travails of Fröhlich with detailed discussions on the theory of dielectrics. The political upheavals in Europe during the 20th century provide a dramatic backdrop for the narrative.

The volume has a total of seven chapters—five main chapters that are bookended by a prologue (chapter 1) and an epilogue (chapter 7). Chapter 2 focuses on Fröhlich's early life in Germany and portrays a mind relentlessly at work on pivotal physics problems, such as the photoelectric effect. When he was dismissed from his appointment as Privatdozent at the University of Freiburg in 1933 under the "cleansing" laws for Jews, Fröhlich used the back of his letter of dismissal to perform useful calculations. Hyland shines a spotlight on his subject's courage by describing Fröhlich's perilous efforts to retrieve his family's assets that had been confiscated by the Butcher of Warsaw, Josef Meisinger. This courage is also highlighted in chapter 3, which documents Fröhlich's life in exile, by his single-minded pursuit of semiconductor physics that was held in low esteem at that time as "dirt physics."

When he eventually escaped the Nazis by traveling through Strasbourg to Leningrad to take up an offer from Yakov Frenkel, Fröhlich took the time to write a paper with Hans Bethe on superconductivity. This is another fine example of his relentless creativity. Hyland makes it clear that Fröhlich put his nimble mind to good use not only to advance condensed-matter theory but also to survive under a series of extraordinarily hostile circumstances. His quick thinking and prior experience in Germany served him well once again in Leningrad, when he anticipated Joseph Stalin's Great Purge and had to convert his rubles into assets that he could take with him to England through Vienna on short notice. On his way to Bristol to work with Nevill Mott, Fröhlich worked with Max Born to develop the crystal-size dependence of the electrical and optical properties of small metal particles.

Chapters 4, 5, and 6 describe, respectively, Fröhlich's life in Bristol, his subsequent tenure as professor at the University of Liverpool, and his transition from professor to professor emeritus. Hyland delightfully brings out the irony of a man escaping Hitler and Stalin only to be interned in Shropshire in 1940 as an "enemy alien." The restlessly creative mind of Fröhlich turned lemons into lemonade by setting up a tent university in the internment camp. It is moving and inspirational that Fröhlich was not at all bitter about his horrific wartime experiences but instead published 30 papers between 1939 and 1945, working on subjects ranging from the influence of impurities on dielectric strength to night vision for tanks. In these chapters, an engaging personal narrative is juxtaposed with a detailed treatment of the theory of dielectrics, polaron theory, electron–phonon coupling, and superconductivity. While the intent is to showcase Fröhlich's pioneering work in quantum field theory, the physics sections can be a challenging read for those not well versed in condensed-matter theory.

Hyland excels time and again when he highlights the humanitarian side of Herbert Fröhlich. The book is meticulously referenced and filled with photos and historical letters. Hyland has presented an inspiring account of a trailblazing physicist and outdoorsman who counted Schrödinger, Sommerfeld, and Feynman among his inner circle, and who had a decent shot at killing Adolf Hitler with a steak knife in the 1930s.

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

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