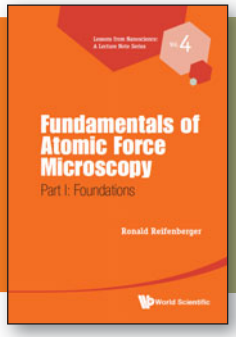


Fundamentals of Atomic Force Microscopy—Part I: Foundations

Ronald Reifenberger

World Scientific, 2015
340 pages, $115.00 (e-book $36.00)
ISBN 978-981-4630-34-4

This book is a set of lectures covering a course on atomic force microscopy (AFM). The overall structure of the book is excellent. It gives a good description of supplementary information needed for the average graduate student to understand the physics of AFM. The density of information, however, is quite heterogeneous. For example, the very important Derjaguin approximation is given with no derivation. At the same time, there is an entire chapter devoted to the topic of van der Waals force, which is rather tangential for force microscopy. The interaction between two nonpolar molecules is described down to the Schrödinger equation, which seems to be excessive.

Every chapter has examples and a summary of the important points, as well as problems to help students understand the material better. The chapters also include suggestions for further reading that are provided through subchapters.

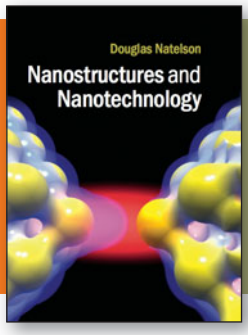
After a brief introduction (chapter 1), there is a description of intermolecular and interparticle interactions (chapters 2, 3, and 4). These are topics typically not covered in a traditional set of courses. At the same time, knowledge of these forces is paramount for an understanding of force microscopy, regardless of whether we are speaking about fundamentals or practical applications. In practical use, the AFM technique can easily produce countless artifacts. Separating artifacts from real images is an art that requires a good understanding of the contrast formation, which is based on the force interaction between the AFM probe and sample surface.

Chapter 5 briefly describes the elastic response of homogeneous and isotropic materials as well as an introduction to contact mechanics. Chapter 6 is devoted to the quasistatic mechanics of the AFM cantilever. The word "quasistatic" indicates oscillations up to hundreds of kilohertz, which is sufficient for the majority of AFM operations. Chapter 7 describes the structure and basic components of an AFM in detail. The next chapter, "Contact Mode AFM," discusses one of the most basic and popular modes for AFM operation. The force spectroscopy mode is also included in this chapter, where the reader will find out how to calculate and map the elastic modulus, adhesion map, etc. These parts are not typically considered as a variation of the contact mode. Even the noncontact mode and lateral force mode are all considered within this chapter, which might be confusing.

Chapter 9 is devoted to various calibration techniques that are needed for quantitative measurements with AFM. A part of this chapter is used to describe a method for optimization of feedback gains during practical scanning. The last chapter is essentially a manual for the use of free online software describing the motion of the AFM probe during scanning. This software will be useful for students, in particular, those who have recently started to work with AFM.

This book makes an attempt to describe both fundamentals and some practical topics of AFM. Because of the limited space, this book is not self-sufficient. Many topics are described at an introductory level, and further reading is needed for those who want a deeper understanding. The literature listing at the end of each chapter is a comprehensive source for further reading.

Reviewer: Igor Sokolov *is a professor at Tufts University, Medford, Mass., USA.*



Nanostructures and Nanotechnology

Douglas Natelson

Cambridge University Press, 2015
639 pages, $85.00 (e-book $68.00)
ISBN 9780521877008

The basics of nanoscience and the origin of physical properties at the nanoscale are clearly discussed in the 12 chapters in this book, aiming for a balance between depth and understanding. Theories behind fundamental nanoscience concepts are linked with real applications. This book is useful for students in physics, materials science, and chemistry.

The first chapter gives a brief introduction to nanotechnology, length scales of materials, and the structure of the remaining chapters in this book. The second chapter discusses the basics of solid-state physics such as theory of free electrons and different types of lattices. The third chapter talks about metals, semiconductors, and insulators with their band structure and models. Preparation of doped semiconductors employing ion implantation (with experimental setup), magnetic semiconductors, and topological insulators are discussed briefly. The fourth chapter is dedicated to the various processes to prepare nanomaterials, device fabrication tools, and characterizing tools.

The fifth chapter explains various defects and interactions between different

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