

Preface

The aim of this textbook is to introduce *scanning probe microscopy* to graduate students and others wishing to learn about the subject from fundamental principles. The original literature is fascinating but hard going; I had a hard time trying to understand it myself. Therefore this textbook was written in an attempt to save other people's time by explaining the topics in a more easily digestible manner.

The first part of this book covers instrumental aspects and summarizes some basics like the harmonic oscillator. In the parts on atomic force microscopy and scanning tunneling microscopy, the book concentrates mainly on the principles of the methods. A few actually measured images and spectra are shown to demonstrate the principles. In reversed historical order, atomic force microscopy is introduced first since this technique is by far the most frequently used method today.

This book developed from a series of lectures that I gave for more than five years at RWTH Aachen University. To this end, it is mainly written with graduate students in mind. However, since the treatment in the book goes more into greater depth than is possible in a lecture, it is my hope that it will also be useful for professionals in the field, and may serve as a reference book in scanning probe microscopy laboratories.

This textbook is not a historical survey of the field and thus will not concern itself with who did what first. I do not cite the original papers unless I feel that they add something that I could not include here. If as an author you perhaps do not feel cited properly, then you are in good company since Gerd Binnig and Heinrich Rohrer are not cited either. No content in this book is originally from me. I learned everything from the primary and secondary literature, and then reformulated it continuously in the course of teaching the subject.

I was largely able to resist including my own research in this book, so you will not find any studies of epitaxy using the scanning tunneling microscope which I performed over the past years, and no charge transport measurements at the nanoscale using multi-tip scanning tunneling microscopy, which is my current research topic. However, I included some details on frequency modulation atomic

force microscopy, since it is my belief that this technique will become more important in the future.

First of all, I would like to thank Vasily Cherepanov for his careful preparation of most of the figures. Moreover, he was regularly my “sparring partner” when discussing issues that were not clear to me. These discussions helped me a lot in furthering my understanding. I would like to thank Gerhard Meyer, who introduced me to scanning probe microscopy in 1990 and has helped me since then in various circumstances. Also, many thanks to Josef Myslivecek for explaining the lock-in technique to me so clearly that I included it here in exactly the way he explained it to me. Irek Morawski introduced me to the FM–AFM technique and the quartz sensors. I would also like to thank Ruslan Temirov for supplying unpublished images from his work.

I am grateful to Michael Crommie, Don Eigler, Randy Feenstra, Franz Giessibl, Markus Heyde, Saw-Wai Hla, Wilson Ho, Gerhard Meyer, Oded Millo, Markus Morgenstern, Nacho Pascual, Udo Schwarz, Jens Wiebe, and Roland Wiesendanger for permitting me to reproduce images from their seminal works.

I would like to thank my former students Anna Strozecka, Stefan Korte, Martin Scheufens, Martin Lanius, Marcus Blab, and Richard Spiegelberg for intense discussions on various topics and for supplying material from their work. A special acknowledgement is due to Janet Carter-Sigglow for her language support. I am grateful to Helmut Stollwerk and Peter Coenen for their continuous support over the years.

I would also like to thank my son Felix for his help in typesetting some of the equations in \LaTeX . My son Paul helped me to solve some equations using a computer algebra system.

I would like to stay in contact with readers via the webpage www.mprobes.com/SPMbook. On this page, supplementary material as well as errata will be posted. It also provides a discussion forum and the opportunity to contact me, in order to report errors, or ask questions.

Finally, it is my hope that this book will enable the reader to operate a scanning probe microscope successfully and understand the data obtained with the microscope.

Jülich, Aachen

Bert Voigtländer

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