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Scanning Tunneling Microscopy III

Theory of STM and Related Scanning Probe Methods

Second Edition
With 212 Figures

Springer

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Preface to the Second Edition

When the first edition of *Scanning Tunneling Microscopy III* appeared, a gap in the literature on scanning probe methods (SPM) was filled because this book offered the first comprehensive overview of the theoretical background and concepts important for understanding image contrast formation and spectroscopic data. As a consequence, the first edition soon sold out and this second edition with an updating chapter, including the most recent developments in the theory on SPM, was prepared. The editors would like to thank all contributors who supplied material for the additional chapter, and those who have provided us with suggestions for further improvements. We also thank Springer-Verlag for the decision to publish this second edition in paperback, thereby making this book affordable for an even wider circle of readers.

Hamburg, January 1996 *R. Wiesendanger*

Preface to the First Edition

While the first two volumes on Scanning Tunneling Microscopy (STM) and its related scanning probe (SXM) methods have mainly concentrated on introducing the experimental techniques, as well as their various applications in different research fields, this third volume is exclusively devoted to the theory of STM and related SXM methods. As the experimental techniques including the reproducibility of the experimental results have advanced, more and more theorists have become attracted to focus on issues related to STM and SXM. The increasing effort in the development of theoretical concepts for STM/SXM has led to considerable improvements in understanding the contrast mechanism as well as the experimental conditions necessary to obtain reliable data. Therefore, this third volume on STM/SXM is not written by theorists for theorists, but rather for every scientist who is not satisfied by just obtaining real-space images of surface structures by STM/SXM.

After a brief introduction (Chap. 1), N.D. Lang first concentrates on theoretical concepts developed for understanding the STM image contrast for single-atom adsorbates on metals (Chap. 2). A scattering-theoretical approach to the STM is described by G. Doyen (Chap. 3). In Chap. 4, C. Noguera concentrates on the spectroscopic information obtained by STM, whereas the role of the tip atomic and electronic structure in STM/STS is examined more closely by M. Tsukada et al. in Chap. 5. The tunneling time problem is still of great topical interest, not only in conjunction with STM, and will therefore be focused on in a separate Chap. 6 by C.R. Leavens and G.C. Aers. A unified perturbation theory for STM and SFM is described by C.J. Chen in Chap. 7. The important issue of tip–sample interaction in STM and related SXM methods is addressed in two separate chapters (Chap. 8 by S. Ciraci and Chap. 9 by U. Landman). Chapter 10 by G. Overney is devoted to contact-force microscopy on elastic media, whereas theoretical concepts of atomic scale friction are described by D. Tománek (Chap. 11). Finally, U. Hartmann concentrates on the theory of non-contact force microscopy (Chap. 12).

We would like to thank all the contributors who have contributed to this third volume on STM, as well as Springer-Verlag for the continuous pleasant collaboration. Hopefully, this third volume on the theory of STM/SXM will help many experimentalists to better understand their data, and will stimulate even more theorists to concentrate on still unsolved issues in the exciting and challenging field of STM and related scanning probe methods.

Hamburg, March 1993

R. Wiesendanger
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