Book Review

SCANNING FORCE MICROSCOPY
With Applications to Electric, Magnetic and Atomic Forces

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In a Scanning Tunneling Microscope [1], an electronic current flows through the tunneling barrier between an atomically sharp tip and a conductive surface. Roughly speaking, the variations of the tunneling current during sample scanning by the tip provide images that may reflect the atomic structure of the surface. However, this microscope fails to observe insulators. In 1986, G. Binnig, C.F. Quate and C. Gerber used a small cantilever ending in a tip to sense the force between the tip atoms and the scanned surface. To measure the deflections of the cantilever, an STM tip was employed, resulting in the first Atomic Force Microscope (AFM) [2].

D. Sarid's book tackles the most recent investigations on this subject. It is divided into three sections. The first one discusses levers as well as the noise induced by detection systems and it includes three chapters. In the first chapter, the author deals with the mechanical properties of the cantilever such as their spring constant in terms of Young modulus and geometry. The second chapter describes resonance enhancement when a vibrating lever is close to the sample. In this case, the force derivative gives rise to a new effective spring constant which affects the resonance frequency of the cantilever. The third chapter presents the noises induced by the lever, the force sensing tip and the deflection probe system. These noise considerations are also evoked in the following chapters mainly because they limit the resolution of the Scanning Force Microscope.

The second section accurately describes the various existing Scanning Force Microscopes. This part comprises seven chapters presenting each a new lever-deflection method: tunneling, capacitance, homodyne, heterodyne, laser-diode feedback, polarization and optical deflection. Except for chapter 4 (which is more complete), the structure always remains the same. After a brief introduction, the author presents the theory, the noise aspect along with the performance of the scanning force microscope.

The last three chapters, included in the third section, are more theoretical in outlook and deal with the theory, operating principle and performance of three scanning tunneling microscopes: electric field (chap. 11), magnetic force (chap. 12) and atomic force microscope (chap. 13). As the chapters 11 and 12 comprise basic concepts, examples, operating principle, noise aspect, applications and performance of electric force and magnetic force microscopy, the last chapter details microscopic and macroscopic interactions between the tip atoms and the surface of a sample. The discussion on AFM is then followed by a brief comparison of atomic, electrostatic and magnetostatic interactions follows.

More generally, each application is followed by numerous experimental examples and gives a sufficient number of references providing the interested reader with a better insight into these new technologies.

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References

[1] BINNIG G., ROHRER H., *Helv. Phys. Acta* **55** (1982) 726.
[2] BINNIG G., QUATE C.F., GERBER C., *Phys. Rev. Lett.* **56** (1986) 930.

Unlike Scanning Tunneling Microscopes, the Atomic Force Microscope does not need a conducting sample. Instead of using the quantum mechanical effect of tunneling, atomic forces are used to map the tip-sample interaction.Â Traditionally, most Atomic Force Microscopes use a laser beam deflection system where a laser is reflected from the back of the reflective AFM lever and onto a position-sensitive detector. AFM tips and cantilevers are typically micro-fabricated from Si or Si3N4. Typical tip radius is from a few to 10s of nm. Laser beam deflection for atomic force microscopes. Measuring Forces.Â Our sales, applications and service teams work together to provide expert advice and solutions to our customers. About Us Contact. News Essentially, a magnetic force microscopy (MFM) is a variant of an Atomic Force Microscope (AFM) typically used for scanning and studying surfaces with magnetic properties. The probe (scanning tip) of the magnetic force microscope has a magnetic coating that allows the device to measure magnetic fields. This makes MFM ideal for imaging the spatial distribution of the magnetic field of such objects as magnetic tapes. Main Parts of a Magnetic Force Microscope. https://blog.brukerafmprobes.com/guide-to-spm-and-afm-modes/magnetic-force-microscopy-mfm/. Piezoscanner (piezoelectric scanner) - This is Sarid D (1991) Scanning force microscopy, with applications to electric, magnetic and atomic forces.Â Wiesendanger R (1994) Scanning probe microscopy and spectroscopy, methods and applications. Cambridge University Press, Cambridge, UKCrossRefGoogle Scholar. Miles MJ (1994) In: Spells SJ (ed) Characterization of solid polymers, Chap.