

Scanning probe microscopy for magnetism

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The concept of scanning probe microscopy (SPM) emerged from the invention of the scanning tunneling microscope in 1982, its importance being quickly recognized by the Nobel prize in Physics in 1986. The versatility of SPM comes from the ability to combine the concept of scanning, with many types or probes, sensitive to various physical quantities, including magnetic ones. In this lecture I will review SPM with a magnetic sensitivity.

Lecture topics:

1. Why do we need magnetic microscopies?
2. The early days of scanning probe microscopy: STM and AFM
3. Magnetic force microscopy (MFM)
 - a. Conventional MFM
 - b. Magnetic resonance force microscopy (MRFM)
4. Spin-polarized STM (sp-STM)
 - a. Early days and basics
 - b. Current trends
5. Scanning Near-field Optical Microscopy (SNOM)
6. Nitrogen-vacancy center microscopy
7. Scanning devices
 - a. Scanning SQUID
 - b. Scanning Hall probes
 - c. Scanning spintronic sensors
8. Overview: assets of the various techniques

Recommended reading:

- [1] H. Hopster, H. P. Oepen, *Magnetic microscopy of nanostructures*, Springer, (2005).
- [2] Y. Zhu Ed., *Modern techniques for characterizing magnetic materials*, Springer (2005).
- [2] A. Schwartz et al., *Scanning probe techniques: MFM and SP-STM*, in : series Handbook of magnetism and advanced magnetic materials, Novel techniques for characterizing and preparing samples (vol.3), H. Kronmüller, S. Parkin Ed. (2007).