# Nanomagnetic Studies On Thin Films And Multilayers With Spin Polarized Scanning Tunneling Microscopy

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Since its invention by Binnig and Rohrer[1], the scanning tunneling microscope (STM) has revolutionized surface physics research due to its unprecedented spatial resolution combined with its spectroscopic capabilities. Very soon were the first attempts to develop an STM with spin sensitivity. Knowledge about the magnetic structures on very small scales is believed to be crucial for the fundamental understanding of micromagnetism and the controlling of magnetic media and devices in the future. The development of the spin-polarized scanning tunneling microscope (SP-STM) to map the spin structure at surfaces down to the atomic level has been an aim of many studies in the past. An instrument with this high resolution would offer fundamentally new insights into the real space order of antiferromagnets, ferromagnets, and ferrimagnets at irregular defects such as dislocations, steps or atomic point defects, which are inaccessible to scattering techniques.

Many different experimental approaches have been proposed: Wiesendanger *et al.*[2] Alvarado *et al.*[3], Vázquez de Parga *et al.*[4], Prins, *et al.*[5] Suzuki, *et a.l* [6], Bode *et al.* [7], Wulfhekel *et al.*[8]. In the successful approach proposed by Bode *et at.*[7] a clean tungsten tip is covered with a layer of magnetic material (ferromagnetic or antiferromagnetic) and the tunneling current depends on the relative orientation of the magnetization of tip and sample. With this method it has been possible to take images of magnetic structures down to the atomic level (Heinze *et al.*[9], Yamada *et* a*l.* [10]). surpassing the lateral resolution of any other magnetic sensitive technique.

The main limitation in the SP-STM experiments till now is that it is very difficult to obtain quantitative information about the surface magnetism. In this presentation we will discuss how to overcome this difficulty using Mn layers grown on an Fe(001) whisker as sample.

As the SP-STM can now be applied quite routinely it comes within reach to study more complicated magnetic structures. As examples magnetic multilayers (Fe/Mn/Fe(100) and AuMn/Mn/Fe(100)) and the complicated structure around a screw dislocation (Fig. 1) will be discussed.

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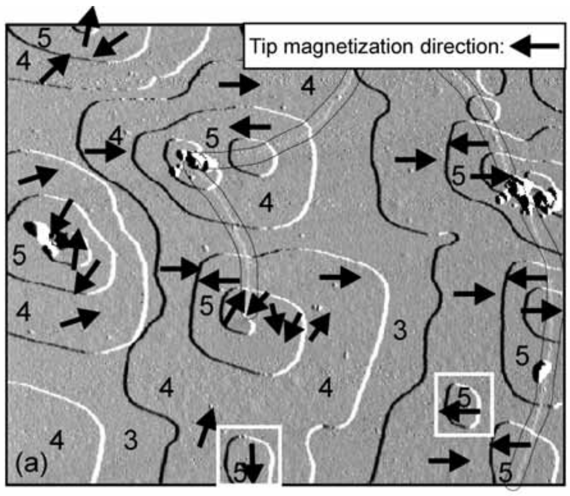


Fig. 1 SP-STM observation of the complicated magnetic structure around a screw dislocation. The sample consists of an average of 4.5 monolayers of Mn on Fe(100). The numbers indicate the number of Mn layers present. A screw dislocation is located somewhat at the lower left of the center of the figure. Buried steps at the Fe surface are visible as weak white lines surrounded, for better visibility, by drawn thin black lines.