NANO HIGHLIGHT
Spin-Polarized Scanning Tunneling Microscopy: a Tool for the Study of Nanomagnetism
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As electronic devices continue to become smaller and faster, it is increasingly important to explore the properties of the basic building blocks of these devices (i.e. transistors and magnetic bits) as their size approaches the nanoscale. In particular, the field of nanomagnetism is attracting many researchers due to the importance of this field to the future technology. Yet a question arises: how can one measure magnetic properties at such small (nanoscale) sizes?

The answer is a powerful technique known as “spin-polarized” scanning tunneling microscopy (SP-STM). The “spin” of an electron is one of its fundamental quantum mechanical properties. When a large group of spins “line up”, a small magnetic “bit” is formed. We are interested in studying magnetic bits whose size approaches that of single atoms. The method of SP-STM works by approaching a sharp, needle-like magnetic probe tip to the sample surface to within a distance of just 1 or 2 atomic diameters. When a small voltage is applied between tip and sample, a tiny “tunnel” current flows. The tunnel current depends on the relative orientation of tip and sample spins. The signal looks like a series of peaks whose height is modulated, as in Fig. 1.

Interesting results on Mn$_3$N$_2$ (010) are obtained as a function of voltage. Shown in Fig. 2 are the images obtained at 2 opposite voltages. Adjacent rows have opposite spin directions, indicated by the modulation of the height of the line profiles. However, the polarity of the STM contrast depends on the voltage. This result is important for measurement of nanoscale magnetic structures.

References

1 For further information about this project link to http://nsnm.phy.ohiou.edu or email smitha2@ohio.edu or hla@helios.phy.ohiou.edu or ulloa@helios.phy.ohiou.edu or sandler@helios.phy.ohiou.edu.