Force-Based Reading and Writing of Single-Atom Magnets

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The integration of single-atom bits represents the highest data density memory [1,2]. Reading and writing information to these bits through mechanical interactions offers the possibility of controlling devices with low heat generation [3,4].

To achieve this visionary goal, we demonstrate the use of non-contact atomic force microscopy (NC-AFM) to read and control the spin orientation of individual holmium atoms on MgO thin films, employing magnetic tips at 4.5 K under external magnetic fields. Holmium (Ho_{top} and Ho_{bridge}) and cobalt (Co) atoms are observed using scanning tunneling microscopy (STM), as shown in Fig. 1. We show the NC-AFM image and tip-sample distance dependence of magnetic signals measured by a magnetic tip. The spin orientation is controlled by approaching the tip closer to the Holmium atom. Our findings open up the possibility of achieving information storage with less dissipative current.

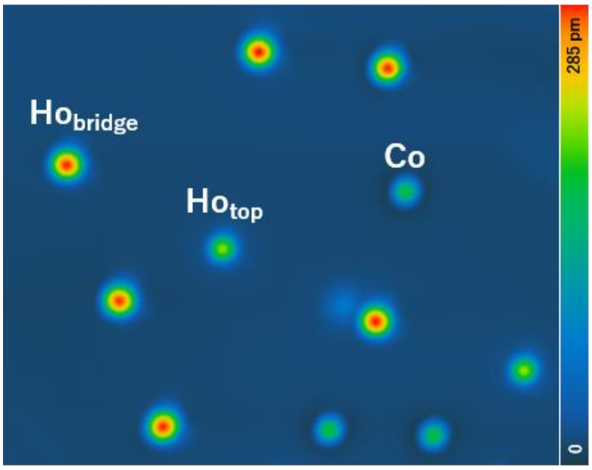

Figure 1. STM image of holmium and cobalt atoms on a MgO/Ag(001). Imaging condition: Constant current mode. V = 200 mV, I = 1.0 nA, T = 4.5 K and B = 3.0 T. Ho_{top} adsorbs on top of the oxygen site of MgO, while Ho_{bridge} is located at the bridge site between oxygen atoms. Co is adsorbed on top of the oxygen site of MgO.

Reference

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