Magnetic Anisotropy of Nanostructures at Surfaces

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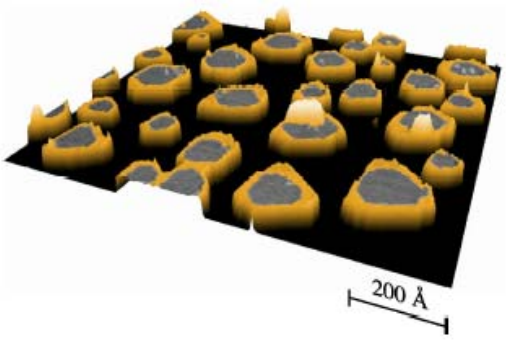
The magnetic anisotropy energy *K* is one of the key quantities in the design of novel magnetic recording media, as it defines the stability of the magnetization direction against thermal fluctuations and therefore the so-called superparamagnetic density limit where magnetic information becomes volatile. Using X-raymagnetic circular dichroism (XMCD) and Magneto-optical Kerr effect (MOKE) we investigate the magnetic properties of 2D nanostructures *in-situ* to their MBE growth at surfaces. A one-to-one comparison of the magnetism of the particle ensemble with their morphology determined with STM enables us to identify the contribution of the differently coordinated atoms. We find spectacular magnetic properties for low coordinated atoms at surfaces.
For Co/Pt(111) we find that edge atoms have 20–times the Cohcp bulk anisotropy and favor out-of-plane magnetization **[1]**. This result is corroborated by XMCD measurements, where we follow the evolution of *K* as a function of size almost atom by atom. This is enabled by the stepwise increase of the mean island sizein the course of coarsening by cluster diffusion **[2]**. The most spectacular result is obtained for monomers having 200–times the bulk *K*–value **[3]**. Currently, the best homogeneity of magnetic properties is obtained for Co islands selfassembled on Au(778). We show the absence of mutual interactions for this case. With a density of 26 Tera in-2, and the narrow *K*–distribution Co/Au(788) presents a model system for exploring the ultimate density limits of magnetic information storage **[4]**. We finally show our attempts to image the individual magnetization directions with spin polarized STM **[5]** and we discuss firstresults obtained on bi-metallic islands.



Tailoring magnetic properties in bi-metallic islands. 3D view of an STM image of one monolayer high islands with a Pt core and an approximately 3 atom wide Co shell (deposition of 0.2 ML Pt at 130 and annealing to 760 K generates the quasi hexagonal nonmagnetic core; subsequent deposition of 0.2 ML Co at 220 K creates the Co rim). In the STM topographs, Co can be discerned from Pt by its 0.3 Å larger apparent height which was used as color code. Due to the anisotropy being mainly caused by perimeter atoms, the Co-rim–Pt-core islands have the same anisotropy as the pure Co islands with equal perimeter length, however, their moment is much smaller due to the nonmagnetic core (figure taken from ref. **[1]**).

References:

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[3] P. Gambardella*, et al.*, Science **300**, 1130 (2003).

[4] N. Weiss, T. Cren, M. Epple, S. Rusponi, G. Baudot, V. Repain, S. Rousset, and H. Brune, submitted (2004).

[5] S. Rusponi, T. Cren, N. Weiss, M. Epple, and H. Brune, submitted (2004).