O 5: Magnetic Nanostructures

Time: Monday 11:15–12:45 Location: MA 043

O 5.1 Mon 11:15 MA 043

Probing the surface states of single atoms on cobalt nanoislands — •Laurent Limot[1], Benjamin Heinrich[1], Mircea-Vasile Rastei[1], Cristian Iacovita[1], Pavel A. Ignatiev[2], Valeri S. Stepanyuk[2], Patrick Bruno[2], and Jean-Pierre Bucher[1] — [1]Institut de Physique et Chimie des Matériaux de Strasbourg, UMR 7504, Université Louis Pasteur, F-67034 Strasbourg, France — [2]Max-Planck-Institut für Mikrostrukturphysik, D-06120 Halle/Saale, Germany

With the remarkable downscaling of data-storage bits, both writing and reading processes become extremely challenging, since read sensors need to be comparable to the bit size, and at the same time, their sensitivity must be improved due to the loss in signal-to-noise ratio. Future progress strongly relies on our fundamental understanding of magnetic phenomena in reduced dimensions.

Atoms on magnetic nanoislands represent a model playground for investigating such phenomena. In this study, we focus on the electronic properties of single Ni, Cu and Co atoms adsorbed on cobalt nanoislands grown on the Cu(111) surface. By combining low-temperature scanning tunneling spectroscopy with *ab initio* calculations we reveal the existence of a common electronic resonance, resulting from the localization of the nanoisland surface states at the adsorption site of the atoms.

O 5.2 Mon 11:30 MA 043

Tailoring exchange interactions between magnetic adatoms in engeneered nanostructures: ab initio study — •Pavel A. Ignatiev, Valeri S. Stepanyuk, and Patrick Bruno — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle, Germany

The controllable modification of quantum states in 1D nanostructures could permit one to manipulate their electronic and magnetic properties. An advanced experimental methods, such as the scanning tunneling microscope (STM), allows one to construct chains on surfaces in atom-by-atom fashion [1,2]. Our ab initio calculations unambiguously demonstrate that both sign and magnitude of the exchange interaction between magnetic impurities incorporated in nonmagnetic chains on metal surfaces can be tailored by an appropriate design of the chain length and composition [3]. Such engineered 1D systems are experimentally feasible [4], and the above effects should be detectable with modern technology, for instance, by probing the Kondo resonance [5].

[1] S. Folsch, P. Hyldgaard, R. Koch, and K. H. Ploog Phys. Rev. Lett. 92, 056803 (2004).

[2] N. Nilius T. M. Wallis, and W. Ho, Science 297, 1853 (2002).

[3] P. A. Ignatiev, V. S. Stepanyuk and P. Bruno, submitted to PRL

[4] J. Lagoute, C. Nacci, and S. Folsch Phys. Rev. Lett. 98, 146804 (2007).

[5] P. Wahl, P. Simon, L. Diekhoner, V. S. Stepanyuk, P. Bruno, M. A. Schneider, and K. Kern, Phys. Rev. Lett. 98, 056601 (2007).

O 5.3 Mon 11:45 MA 043

***Ab initio* Study of Spin-polarized Bound States in Magnetic Dimers on Metal Surfaces** — •Oleg O. Brovko, Valeri S. Stepanyuk, and Patrick Bruno — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle, Germany

Interaction of single adatoms with surface state electrons has been shown to produce a bound state below the surface state band bottom [1,2]. Similar states have been revealed at nonmagnetic Cu chains [2]. Using *ab initio* KKR Green's function method we study the spin-polarized bound state arising at magnetic dimers on noble metal surfaces. We demonstrate that the spin-splitting of the bound state can be utilized to determine the exchange coupling of a magnetic dimer.

[1] L. Limot, E. Pehlke, J. Kröger, and R. Berndt, Phys. Rev. Lett. 94, 036805 (2005). [2] V. S. Stepanyuk, A. N. Klavsyuk, L. Niebergall, and P. Bruno, Phys. Rev. B 72, 153407 (2005)

O 5.4 Mon 12:00 MA 043

Quantum resonators on metal surfaces: theoretical and experimental studies — •L. Niebergall[1], N.N. Negulyaev[2], V.S. Stepanyuk[1], P. Bruno[1], J. Repp[3], G. Meyer[4], and K.-H. Rieder[5] — [1]Max Planck Institute of Microstructure Physics, 06120 Halle, Germany — [2]Physics Department, Martin-Luther-University Halle-Wittenberg, 06099 Halle, Germany — [3]Institute of Experimental and Applied Physics, University Regensburg, 93053 Regensburg, Germany — [4]IBM Research, Zurich Research Laboratory, 8803 Rueschlikon, Switzerland — [5]Institute of Experimental Physics, FU Berlin, 14195 Berlin, Germany

Confinement of surface-state electrons on metal surfaces can lead to many interesting effects [1-3]. Here, we present a combined experimental and theoretical studies on adatom motion in quantum resonators. Using STM technique we construct two parallel monatomic Cu chains on Cu(111). Quantum confinement of surface electrons between chains is revealed. Experimental and theoretical studies demonstrate that adatom motion inside the resonators at low temperature is determined by quantized electronic states in resonators.

1. V.S. Stepanyuk et al., Phys. Rev. Lett. 94, 187201 (2005).
2. L. Niebergall et al., Phys. Rev. Lett. 96, 127204 (2006).
3. V.S. Stepanyuk et al., New J. Phys. 9, 388 (2007).

O 5.5 Mon 12:15 MA 043

Self-organized surface ripples as a source of magnetic anisotropies — •J. Fassbender[1], M. O. Liedke[1], A. Keller[1], S. Facsko[1], D. Marko[1], A. Hanisch[1], J. Grenzer[1], E. Cizmar[2], and S. Zvyagin[2] — [1]Forschungszentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Bautzner Landstrasse 128, 01328 Dresden, Germany — [2]Forschungszentrum Dresden-Rossendorf, High Magnetic Field Laboratory, Bautzner Landstrasse 128, 01328 Dresden, Germany

In thin film magnetism surface and interface morphologies are important sources of magnetic anisotropy. This can be either due to the reduced coordination of step edge atoms (intrinsic contribution) or due to magnetic stray fields emanating from the film corrugation (extrinsic contribution). Low energy ion erosion is perfectly suited to create a periodic surface modulation (so-called ripples) on the nanoscale. By changing the primary energy of the ions the ripple periodicities can be varied from 20 to 150 nm. Subsequently, thin magnetic films are deposited on these template systems in order to investigate the influence of the surface morphology on the induced magnetic anisotropies. For small ripple periodicities a strong uniaxial magnetic anisotropy is found which rapidly decrease for larger ripple periodicities. In the case of Permalloy ($Ni_{81}Fe_{19}$) the induced anisotropy can be more than a factor of 20 larger compared to the intrinsic anisotropy of flat Permalloy. The microscopic origin of this effect will be discussed.

O 5.6 Mon 12:30 MA 043

Magneto-optical study of hexagonal hole arrays in thin magnetic films — •Georgios Ctistis[1], Evangelos Papaioannou[2], Piotr Patoka[1], Paul Fumagalli[2], and Michael Giersig[1] — [1]Nanoparticle Technology Department, Center of Advanced European Studies and Research, 53175 Bonn, Germany — [2]Institut für Experimentalphysik, Freie Universität Berlin, 14195 Berlin, Germany

Nanostructured surfaces of optically thin films exhibit interesting optical properties as plasmon assisted transmission and are thus interesting for opto-electronic applications. Using magnetic materials such as Fe or Co instead, could result in tailoring the magnetic properties of the materials at desired frequencies.

In this study we present our magneto-optical studies of hexagonal nano-hole arrays of 100 nm thick magnetic films (Fe, Co, Ni). Different meshes were used with hole diameters ranging between 220 nm and 330 nm, while the inter-hole distance was kept constant at 470 nm, respectively. Spectra were taken with a Kerr-spectrometer in the range of 0.8 - 5 eV. A strong change in the response depending on the hole geometry compared to the corresponding closed films is observed. Furthermore, recorded hysteresis loops reveal the magnetization process as a function of the underlying geometry.