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**H. Zhang, U. Memmert, R. Houbertz and U. Hartmann**
A VARIABLE-TEMPERATURE ULTRAHIGH VACUUM SCANNING TUNNELING MICROSCOPE

A variable-temperature ultrahigh vacuum (UHV) scanning tunneling microscope (STM) was designed and tested. Design details and initial results are presented. The STM is directly attached to the cold face of a continuous flow cryostat which is mounted into a two-chamber UHV system. A significant advantage of this system in comparison to many others is, that samples can be cooled down to base temperature of 6.5 K within very short times of below 2 h. This feature not only increases the potential sample throughput, it also allows to cycle the sample temperature within the regime below 20 K without losing track of given sample locations. The instrument was tested by imaging Au layers on graphite. The vertical stability at low temperature was found to be below 3 pm. Images recorded at 6.5 K show crystalline Au islands and the Au(111)22× 3 reconstruction with atomic resolution. Using a resistive heater, the sample temperature was adjusted between 6.5 and 20 K. After an equilibration time of 15 min, the displacement due to the temperature change remained below 150 nm. Scanning tunneling spectroscopy on Au(111) grains resolves the Au(111) surface state.

*Rev. Sci. Instr.* ***72****, 2613 (2001)*

**Y. Xu, U. Memmert, and U. Hartmann**
MAGNETIC FIELD SENSORS FROM POLYCRYSTALLINE MANGANITES

We report on the fabrication of magnetic sensors based on bulk $La_{0.67}Sr_{0.33}MnO_3$ and $La_{0.67}Ba_{0.33}MnO_3$ material. The sensors were characterized at fields of 0–8 T and temperatures of 4.2–300 K. The sensors display a maximum sensitivity of ≈200%/T at room temperature within a field range of 1–3 mT. For the sensor geometry investigated here, the low-field magnetoresistance (MR) of the sensors measured in three field orientations with respect to the sensor plane is strongly anisotropic. The high-field MR, in contrast, is found to be field-orientation independent. Periodic response of the sensor's resistance to the angle between the field and sensor-plane is demonstrated at room temperature.

*Proc. EMSA Conf., Dresden, Germany, 2000; Sensors and Actuators A* ***91****, 26 (2001)*

**J. Lösch, U. Memmert, and U. Hartmann**
UHV MAGNETIC FORCE MICROSCOPY ON IN SITU GROWN IRON THIN FILMS

Ultrahigh vacuum (UHV) scanning tunneling microscopy (STM) and magnetic force microscopy (MFM) were used to investigate the topography and the magnetic domain structure of epitaxial Fe/Ag thin films. Ten-nanometer thick Fe films were grown on in situ prepared Ag(100)/Fe/GaAs(100) substrates. STM images revealed smooth terrace-step structures for the Ag(100) and the Fe(100) layers. The domain structure mainly consists of 90° domain walls. The density of domains increases significantly close to the sample edges and a echelon pattern is formed.

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**J. Jorzick, C. Krämer, S.O. Demokritov, B. Hillebrands, E. Sondergard, M. Bailleul, C. Fermon, U. Memmert, A.N. Müller, A. Kounga, U. Hartmann, and E. Y. Tsymbal**
MAGNETO-DIPOLE COUPLING IN ARRAYS OF MICRON-SIZE RECTANGULAR MAGNETIC ELEMENTS

Static magnetic properties of arrays of micron-size rectangular magnetic permalloy elements are investigated by means of magneto-optic Kerr-effect magnetometry and magnetic force microscopy. The influence of the size and the spacing between the elements on the magnetization curves of the arrays is studied for different orientations of the applied magnetic field. A sizeable magnetic dipole coupling between the elements is found, affecting strongly the magnetic properties of the arrays.

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**H. Gao, M. Oberringer, A. Englisch, R.G. Hanselmann, and U. Hartmann**
THE SCANNING NEAR-FIELD OPTICAL MICROSCOPE AS A TOOL FOR PROTEOMICS

The identification of the entire genetic code of human DNA is more or less completed. With this knowledge, research in identifying the real information lying in the genes, will begin. This information is contained in the proteins, which are the main biological actors in the cell. For this reason proteins will be targeted in biological investigations in the future. The structure, affinity and reactivity of each identified protein have to be determined, which is a primary goal in the field of proteomics. This will require new and better strategies to identify protein–protein interaction. Our approach, based on the detection and visualization of single proteins by scanning near-field optical microscopy (SNOM), has allowed us to visualize various fixed and fluorochrome-labelled proteins at the nanometer scale. Subsequently SNOM may then be developed to efficiently detect the specific behavior of a certain protein in response to other biomolecules.

*Proc. Scanning Probe Microscopy, Cantilever Sensors, and Nanostructures Conf., Heidelberg, Germany, 2000; Ultramicroscopy* ***86****, 145 (2001)*

**U. Weber, R. Houbertz, and U. Hartmann**
MODIFICATION OF THIN GOLD FILMS WITH SCANNING TUNNELING MICROSCOPE

Thin gold films, which were deposited by sputter deposition onto highly oriented graphite surfaces, were investigated and modified by means of a scanning tunneling microscope. By applying short voltage pulses to the vertical piezoelectric element or to the tunneling tip, hole patterns were generated. Physical mechanisms underlying the modifications are discussed for the two methods.

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**A. Wienss, M. Neuhäuser, H.-H. Schneider, G. Persch-Schuy, J. Windeln, Th. Witke, and U. Hartmann**
MECHANICAL PROPERTIES OF DC MAGNETRON-SPUTTERED AND PULSED VACUUM ARC DEPOSITED ULTRA-THIN NITROGENATED CARBON COATINGS

Nitrogenated carbon coatings (CNx) are widely used as protective coatings on magnetic hard disks. In this paper, the mechanical properties of such coatings produced with d.c. magnetron-sputtering and filtered high-current vacuum arcs (HCA) are compared. An AFM-based scratching technique has been used that allows the generation and characterization of scratches with residual depths in the Å range. With this technique, the very beginning of plastic deformation and the scratching resistance of ultra-thin coatings (5 nm) can be investigated. The scratching resistance of different sets of films was compared to Raman spectra, X-ray photoelectron spectroscopy (XPS) and surface acoustic wave (SAW) measurements. For samples with a higher resistance against mechanical penetration on a sub-nanometer scale, a higher Young's modulus and a downshift of the Raman G and 700 cm−1 peak position was observed. It turned out that for magnetron-sputtered films, the resistance against mechanical penetration increases with higher nitrogenation, whereas the films produced by HCA show an inverse tendency. The scratching resistance and the Young's modulus of HCA films decrease nearly linearly with increased deposition temperature.

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**U. Hartmann**
NANOBIOTECHNOLOGIE - EINE BASISTECHNOLOGIE DES 21. JAHRHUNDERTS
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**M. R. Koblischka and U. Hartmann**
AUF DEM WEG ZU ANWENDUNGEN DER HOCHTEMPERATUR-SUPRALEITER – OPTIMIERUNG AUF NANOMETERSKALA
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