Publikationen 1998

U. Hartmann
ATOMIC FORCE MICROSCOPY
*in: **Metals As Biomaterials**, eds. J. A. Helsen and J. Breme (Wiley, London, 1998)*

B. Hoffmann, R. Houbertz, and U. Hartmann
EDDY CURRENT MICROSCOPY

Oscillating ferromagnetic probes, as typically used in magnetic force microscopy (MFM), induce eddy currents within conducting materials. These currents lead to an electrodynamic interaction between the probe and sample. As a consequence, the oscillation of the probe is affected, leading to a contrast in the phase, amplitude, or frequency-shift image. Eddy current imaging is highly sensitive to local variations in the material composition, even involving the analysis of subsurface features. Furthermore, it is possible to image stray fields of ferromagnetic domains and walls with nonmagnetic but conducting probes being oscillated at close proximity to magnetic samples. The latter configuration induces eddy currents within the probe, leading to images with a resolution comparable with that of MFM. In order to understand the contrast, the induced eddy current density and the resulting force between probe and sample are calculated by solving the Helmholtz equation for a dipole oscillating above a conducting surface. Theory and experimental data confirm that eddy current microscopy (ECM) is a new powerful tool providing force microscopy with a certain material-sensitive contrast and additionally permitting an absolutely nondestructive imaging of the softest magnetic materials.

*Proc. STM´97 Conf., Hamburg, Germany, 1997; Appl. Phys. A **66**, S409 (1998)*

U. E. Volmar, U. Weber, R. Houbertz, and U. Hartmann
I(V) CHARACTERISTICS OF ONE-DIMENSIONAL TUNNEL JUNCTION ARRANGEMENTS

Within the framework of a semiclassical model, an analytical approach is presented to determine Coulomb blockade and single electron tunneling (SET) phenomena for arbitrary tunnel junctions coupled in series. The Coulomb gap in the I(V) curves is obtained as a simple function of the capacitances in the series, and a "recipe" for the determination of particular voltages, at which steps occur, is given. The magnitude of the differential conductivity at the current onset is calculated. The results are useful for a qualitative and quantitative analysis of experimental I(V) curves and are compared with Monte Carlo simulations and experimental data.

*Proc. STM´97 Conf., Hamburg, Germany, 1997; Appl. Phys. A **66**, S735 (1998)*

R. Houbertz, U. Weber, and U. Hartmann
SCANNING TUNNELING SPECTROSCOPY ON AU THIN FILM STRUCTURES DEPOSITED ON HOPG

The local electronic structure of nanoscale Au islands and of Au thin films on highly oriented pyrolitic graphite (HOPG) surfaces is investigated by scanning tunneling microscopy and spectroscopy (STM/STS) in ultra-high vacuum (UHV). The Au islands are produced by field evaporation from the tunneling tip. Thin films are produced ex situ by dc sputter deposition. For all sample types, the I(V) curves show discrete maxima and thus negative differential conductivity. Up to five current maxima were found equally spaced for a voltage range of ±1.5 V. Additionally, variations in the I(V) curves were observed with varying island height. The results are discussed on the basis of a Au/HOPG intercalation process.

*Proc. STM´97 Conf., Hamburg, Germany, 1997; Appl. Phys. A **66**, S149 (1998)*

P. Leinenbach, J. Lösch, U. Memmert, and U. Hartmann
ULTRAHIGH VACUUM MAGNETIC FORCE MICROSCOPY ON IN SITU GROWN IRON THIN FILMS

Ultrahigh vacuum (UHV) magnetic force microscopy (MFM) was used to investigate the magnetic structure of 10 nm thick Fe films. The films were deposited on 50 nm thick Ag films on GaAs(100)/Fe substrates. The film structure was characterized in situ by scanning tunneling microscopy (STM) and low-energy electron diffraction (LEED), showing that the films grow (100)-oriented and that they display a distinct topographic texture. MFM shows that for the as-grown films the magnetization lies within the surface plane. A clear magnetic ripple structure could be identified. Rather irregular domains and 90° domain walls were also imaged. The wall profiles are of Néel type.

*Proc. STM´97 Conf., Hamburg, Germany, 1997; Appl. Phys. A **66**, S1191 (1998)*

J. Lösch, P. Leinenbach, U. Memmert, and U. Hartmann
MORPHOLOGY OF Ag(100) SUBSTRATES: THE INFLUENCE OF THE FILM THICHNESS AND THE ANNEALING PROCESSES STUDIED BY SCANNING TUNNELING MICROSCOPY

Epitaxial Ag(100) thin films were prepared on Fe/GaAs(100) by room temperature deposition. The films were examined by scanning tunneling microscopy (STM) before and after an annealing procedure at 500-600 K. The as-grown films display percolating grains with channels, reaching down to the substrate in-between the grains for 15 nm films, and a number of remaining holes for 75 nm films. The annealing process leads to remarkable changes of the film morphology. For 15 nm films the Ag agglomerates into a few grains, up to 100 nm high. Films of more than 50 nm thickness are converted into completely closed layers with a low surface roughness. The surfaces of these films still show a number of structural defects, which are mainly screw dislocations.

*Proc. STM´97 Conf., Hamburg, Germany, 1997; Appl. Phys. A **66**, S1133 (1998)*

E.M. Siebel, U. Memmert, R. Vogel, and U. Hartmann
IN SITU OBSERVATION OF ELECTROCHEMICAL Cu DEPOSITION BY SCANNING FORCE MICROSCOPY

A scanning force microscope (SFM) for electrochemical applications, based on an optical fiber interferometer for force detection, is developed. Cu bulk deposition and dissolution on polycrystalline Au samples were used to demonstrate the performance of the instrument. The time dependence of the nucleation and deposition of Cu grains and their dissolution was monitored by one-dimensional scanning during the reaction. The data show that SFM in an electrochemical environment can be used to investigate inhomogeneous processes in situ on the micron scale. Problems due to electrochemical processes occurring on the SFM cantilevers are, however, of significance and require special attention.

Proc. STM'97 Conf., Hamburg, Germany, 1997; Appl. Phys. A ***66****, S83 (1998)*

M. Niedereichholz, H. Gao, M. Oberringer, H. P. Sattler, W. Mutschler, U. Hartmann, G. Hanselmann
SCANNING NEAR FIELD OPTICAL MICROSCOPY (SNOM) AND ATOMIC FORCE MICROSCOPY (AFM): NEW TOOLS FOR THE MEDICAL AND BIOLOGICAL RESEARCH
Langenbeck Archives of Surgery ***383****, 5 (1998)*

C. Horstmann, P. Leinenbach, A. Engelhardt, R. Gerber, J. L. Jia, R. Dittmann, U. Memmert, U. Hartmann und A.I. Braginski
INFLUENCE OF RAMP SHAPE AND MORPHOLOGY ON THE PROPERTIES OF YBa2Cu3O7-d RAMP-TYPE JUNCTIONS

The correlation between the shape and the morphology of ramps prepared by ion-beam etching of $YBa_2Cu_3O_{7-\delta}$ thin films, and the properties of ramp-type junctions were investigated in detail. We examined the influence of different fabrication parameters on the $YBa_2Cu_3O_{7-\delta}$ ramps by atomic force microscopy. Ramp-type junctions were fabricated using $PrBa_2Cu_{2.9}Ga_{0.1}O_{7-\delta}$ as barrier material. We observed a strong influence of the shape of the ramp on the homogeneity and, thus, on the transport properties of the junctions. Furthermore, we observed that the roughness of the ramps is strongly influenced by the voltage of the ion-beam during etching. Best results are achieved when an additional wet cleaning step by bromine solution in ethanol is introduced prior to the deposition of the barrier and the top electrode. As a result from our optimization, the on-chip spread of the junction critical current was reduced to 11%.

Physica C ***302****, 176 (1998)*

U. Memmert, P. Leinenbach, J. Lösch, and U. Hartmann
ULTRAHIGH VACUUM MAGNETIC FORCE MICROSCOPY: DOMAIN IMAGING ON IN SITU GROWN Fe (100) THIN FILMS

The design of an ultrahigh vacuum (UHV) magnetic force microscope (MFM) is described. The instrument was applied to investigate the magnetic structure of 10–80 nm thick Fe(100) films grown in situ in UHV on Ag(100) thin film substrates. The domain structure consists mainly of 90° domain walls while only a minority of 180° walls was found. The wall profiles are found to be of Néel type for 10 nm films and of asymmetric Bloch type for 80 nm films.

J. Magn. Mag. Mat. ***190****, 124 (1998)*

U. Memmert und U. Hartmann
VERMESSUNG UND ANALYSE VON NANOSTRUKTUREN - EINE DER GROSSEN INTERDISZIPLINÄREN HERAUSFORDERUNGEN FÜR DIE KOMMENDEN JAHRE
Magazin Forschung ***2****, 34 (1998)*

A. Wienss, F. Krause, G. Persch-Schuy, U. Hartmann
NANOHÄRTEPRÜFUNG AN DIAMANTÄHNLICHEN SCHUTZSCHICHTEN AUF MAGNETSPEICHER-KOMPONENTEN
DVM-Bericht ***518****, 173 (1998)*