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U. Hartmann, A.A. Golubov, T. Drechsler, M. Yu. Kupriyanov and C. Heiden
MEASUREMENT OF THE VORTEX-CORE RADIUS BY SCANNING TUNNELING MICROSCOPY

Using a scanning tunneling microscope operated in a spectroscopic mode we imaged flux-line lattices in niobium diselenide at various external magnetic fields. From the evaluation of a large number of tunneling-current profiles taken across the individual vortices we deduced the dependence of the vortex-code radius on the applied magnetic field. It was found that the core radius shows a pronounced decrease with increasing field, even for H/Hc21. This behavior is qualitatively well characterized by self-consistent solutions of the Usadel equations.

*Proc. LT 20 Conference., Eugene, USA, 1993; Physica B **194-196**, 387 (1994)*

G. Matteucci, M. Muccini, and U. Hartmann
STRAY-FIELD INVESTIGATIONS ON SHARP FERROMAGNETIC TIPS BY ELECTRON HOLOGRAPHY

The leakage field produced by sharp ferromagnetic probes employed for magnetic force microscopy has been investigated by electron holography. Interference fringes obtained with the double exposure technique are found to be in good qualitative agreement with calculations based on a macroscopic dipole model for the sensor tips. We show that it is possible to measure the probes' magnetic flux through the evaluation of the phase difference in the simulated map.

*Proc. SMM 11 Conference, Venezia, Italy, 1993; J. Magn. Magn. Mat. **133**, 422(1994)*

A.A. Golubov and U. Hartmann
ELECTRONIC STRUCTURE OF THE ABRIKOSOV VORTICX CORE IN ARBITRARY MAGNETIC FIELDS

Using a scanning tunneling microscope we imaged Abrikosov vortex lattices in 2*H*-$NbSe_2$. At a reduced temperature of T/T_c=0.6 we found a distinct decrease of the vortex-core radius with increasing magnetic field. Even at low fields $H/H_{c2} << 1$, the effect of vortex-vortex interactions on the spatial variation of the order parameter *Delta* (*rho*), is clearly evident. In order to interpret the experimental results the microscopic equations of the superconducting state are solved self-consistently. A good quantitative agreement is obtained without any variational free parameters.

*Phys. Rev. Lett. **72**, 3602 (1994)*

G. Matteucci, M. Muccini, and U. Hartmann
FLUX MEASUREMENTS ON FERROMAGNETIC MICROPROBES BY ELECTRON HOLOGRAPHY

Bulk ferromagnetic microprobes, as commonly used in magnetic force microscopy, have been analyzed by electron holography. Using the double exposure technique, detailed holograms have been obtained from nickel probes. The resulting two-dimensional interferograms can be well reproduced by numerical calculations which are based on the assumption that the probes stray field is produced by a macrodipole of several micrometers in length. By treating the dipole charge as a variational free parameter to be fitted against the experimental data, it is possible to determine the stray field produced by the probes, their effective leakage flux, and the surface area of a sample which may seriously be affected by the probes stray field. The results are considered especially important for those applications of magnetic force microscopy where the sample is likely to be magnetically perturbed by the stray field which is produced by the imaging probe itself.

*Phys. Rev. B **50**, 6823 (1994)*

U. Hartmann
SCANNING PROBE MICROSCOPY ON SUPERCONDUCTORS: ACHIEVEMENTS AND CHALLENGES

The current status of scanning probe microscopy on superconductors is briefly reviewed. Both tunneling and force microscopy have clearly become valuable tools for topographic surface characterization of superconductors. They have especially contributed to our understanding of growth mechanisms, morphology and surface properties of high-temperature superconductors. Furthermore, scanning tunneling spectroscopy on some special model-type conventional superconductors has provided completely new insight into fundamentals of superconductivity. In the latter respect only moderate success has yet been met for all technically relevant materials and especially for the ceramic materials due to surface quality problems. Very recent results show that magnetic force microscopy may be capable of imaging flux lines in superconductors, even if the surface is non-ideal. Flux-line imaging has already been achieved by employing scanning field probes. Some concrete future challenges concerning the application of scanning probe techniques to the study of superconducting materials and superconductivity are discussed.

*Appl. Phys. A **59**, 41 (1994)*

R. Houbertz, T. Feigenspan, F. Mielke, U. Memmert, U. Hartmann, U. Simon, G. Schön, and G. Schmid
STM INVESTIGATIONS ON COMPACT AU55 CLUSTER PALLETS
*Europhys. Lett. **28**, 641 (1994)*