Stripe and Criss-Cross Patterns in High-T_c Superconductors Reveled by AFM and STM

M.R. Koblischka[1], M.Winter[1], A. Hu[2], M. Murakami[3] and U. Hartmann[1]

[1]*Institute of Experimental Physics, University of Saarbrücken, P.O.Box 151150, D-66041 Saarbrücken, Germany*

[2]*Superconductivity Research Laboratory,* International Superconductivity Technology Center, *1-10-13 Shinonome, Koto-ku, Tokyo 135-0062, Japan*

[3]*Department of Materials Science and Engineering, Shibaura Institute of Technology, Shibaura 3-9-14, Minato-ku, Tokyo 108-8548, Japan*

Electric address: m.koblischka@mx.uni-saarland.de or
http://www.uni-saarland.de/fak7/hartmann/welcome.html

For high-T_c superconductors, it is an important issue to create effective flux pinning sites during the processing steps. Due to the small coherence length in these materials, the investigations have to be carried out on the nanometer scale. Recently, nanostructures ascribed to composition modulations have been found in some superconductors with a mixture of light rare earth ions [1,2]. Tapping mode AFM and STM measurements in ambient conditions were performed on (Sm,Eu,Gd)$Ba_2Cu_3O_x$ ("SEG") superconductors. Here, we discuss the parameters to observe these nanostructures on the surfaces of bulk, high-T_c superconductors.

We employed Digital Instruments Nanoscope III and IV controllers in atomic force microscope (AFM) and scanning tunneling microscope (STM) mode at ambient conditions. The use of both AFM and STM enables one to exclude effects of the tips. For comparison, AFM scans were done in contact mode and tapping mode using doped Si-cantilevers. A Q-control unit was used to improve the signal-to-noise ratio in the tapping mode. STM scans were done using cut Pt/Ir-tips. The sample surfaces were mechanically polished prior to scanning [2], and an etching procedure was applied [3].

The topography scans were performed on a wide area range in order to investigate the homogeneity of the nanopatterns. It was found that the nanostripes go through the entire sample, and their shape is affected by the presence of Y_2BaCuO_5 grains embedded in the superconducting matrix. The observation was found to be only possible on freshly prepared superconductor surfaces These nanopatterns with dimensions around 20 nm are important for the flux pinning behavior of the high-T_c superconductor compounds.

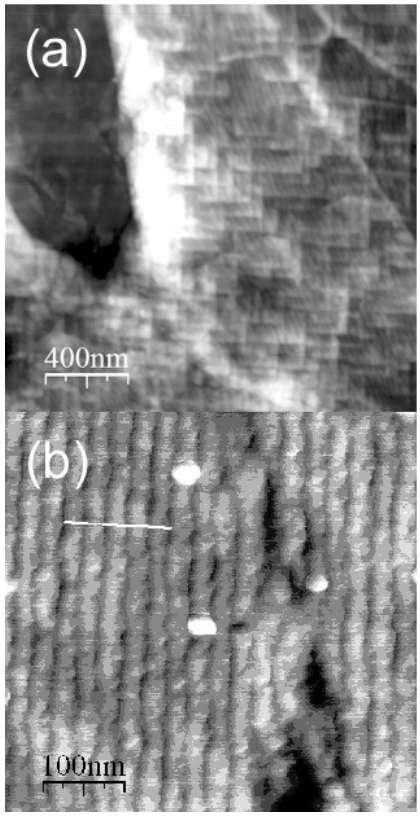

Figure 1 *(a) AFM topography image of SEG, (b) STM at ambient conditions.*

References

[1] A. Hu, M. Winter, H. Zhou, N. Sakai, M.R. Koblischka, M. Murakami, and I. Hirabayashi, Appl. Phys. Lett. 86, 092505 (2005).

[2] M.R. Koblischka, M. Winter, A. Hu. M. Muralidhar, U. Hartmann and M. Murakami, Phys. stat. sol. (c) 2, 1720 (2005).

[3] M. Gurvitch, J. M. Valles, Jr., A. M. Cucolo, R. C. Dynes, J. P. Garno, L. F. Schneemeyer, J. V. Waszczak, Phys. Rev. Lett. **63** (1989) 1008.