Nano-stripe structures in light rare-earth high-T_c superconductors

M. Winter[1], M. R. Koblischka[1], A. Koblischka-Veneva[2], and U. Hartmann[1]

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

The surfaces of light rare-earth-element-based high-T_c superconductors with the composition (LRE)$Ba_2Cu_3O_x$ (with LRE = light rare earths, e.g. Nd, Gd, Sm) reveal the presence of pronounced stripe structures with wavelengths varying between 10 and 60 nm (see Fig. 1). In this contribution, we present a comparison of topographical investigations performed on a variety of samples by means of atomic force microscopy (AFM) and scanning tunneling microscopy (STM) under 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 investigatonss were carried out using cut Pt/Ir-tips. As samples, we employ melt-textured samples, melt-textured samples with nanoparticle additions and single-crystalline samples of the various LRE-superconductors. The sample surfaces were mechanically polished prior to scanning, and an etching procedure was applied. The topographic ivestigations 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 non-superconducting grains embedded in the superconducting matrix; e.g. Y_2BaCuO_5 or other embedded nanoparticles. Using the electron backscatter diffraction (EBSD) technique, we could determine the crystallographic orientation of the nanostripes and the interaction with the always present twin-boundary structure.

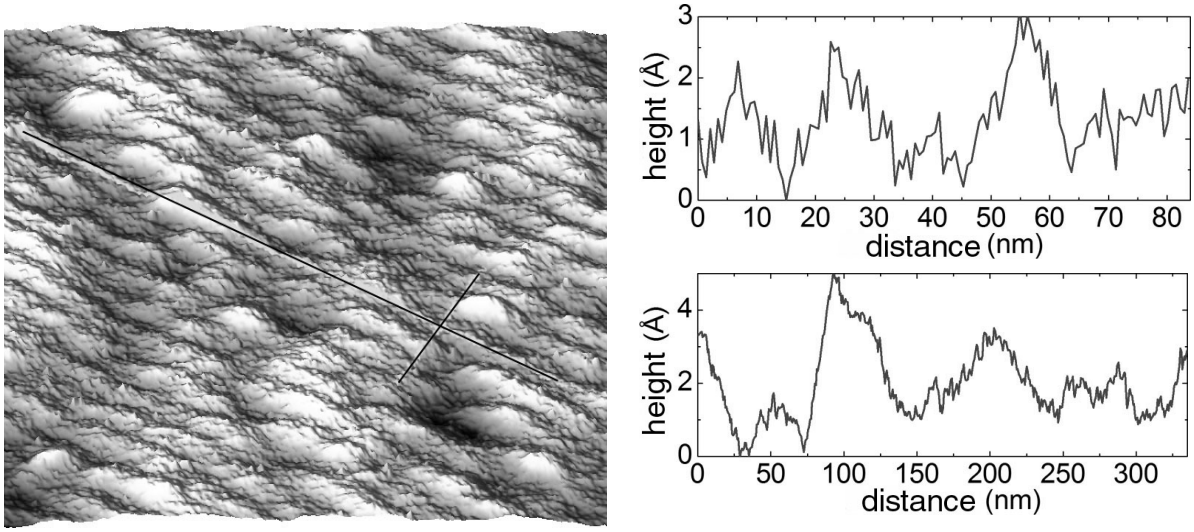

Fig. 1. Nanostripes observed by tapping-mode AFM (300 × 300 nm^2) of a ZnO_2-doped $GdBa_2Cu_3O_x$ melt-textured superconductor.