Hydrogen-Induced Relaxations in Epitaxial Ni-Films on Cu(100)

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In a naive picture epitaxial growth proceeds by pseudomorphic layer-by-layer growth, whereby the film compensates deviations from its native lateral lattice parameter by tetragonal distortions. This scenario is realized in the system Ni/Cu(100) showing a thickness-independent vertical distortion of the entire Ni-film [1]. This tetragonal distortion leads to some unusual magnetic properties of the Ni-films, as e.g. the transition from an in-plane to an out-of-plane magnetization as function of film thickness [2].

Recently it was shown that an about 8 ML Ni-film allows for H-induced reversible switching of the easy magnetization direction from in-plane to out-of-plane. In that case the orientation of the magnetization can be controlled by the H pressure alone. We have analyzed those Ni-films with and without H-adsorption as function of coverage by an in-situ combination of quantitative LEED and STM. While LEED allows for a detailed analysis of the local atomic structure, STM was applied to control the coverage and morphology of the Ni-films. Our full dynamical LEED structure determinations found a heavily expanded first-layer distance for the H-covered Ni-film surface compared to the uncovered Ni-film. It will be discussed whether this structural change is related to the switch of the easy axis of the magnetization.

[1] W. Platow et al, Phys. Rev. B 56 (1999) 12 641
[2] K. Baberschke, Appl. Phys. A 62 (1996) 417