# Thin Co Films Grown On Vicinal Cu Surfaces: Correlation Between Magnetic Anisotropy, Surface Morphology And Crystallographic Distortion

**Hélène Magnan** [1,2], Anne Chaumin Midoir [1], Patrick Le Fevre [1], Fabrice Scheurer [3], Luc Barbier [2], Dominique Chandesris [4]

[1] LURE, Université Paris Sud, 91898 Orsay Cedex, France
[2] CEA/Saclay, DSM/DRECAM/SPCSI, 91191 Gif-sur-Yvette Cedex , France
[3] IPCMS-GSI , 23 rue du Loess, BP 43, 67034 Strasbourg Cedex 2, France
[4] Synchrotron SOLIEIL, L'Orme des Merisiers,Saint-Aubin - BP 48, 91192 Gif-sur-Yvette Cedex, France.( Helene.Magnan@lure.u-psud.fr )

Thin magnetic films deposited on single-crystal substrates are well known to present magnetic properties that cannot be found in bulk solids. One method to elaborate small objets is to evaporate magnetic metal on a nanostructurated substrate like vicinal surfaces with atomic steps. The understanding of magnetic properties of these systems requires a precise determination of their structure and morphology to evaluate the effects of their reduced size and their morphology. We have studied thin cobalt films deposited on Cu(1 1 11) and Cu(115) surfaces by three techniques. Magnetic properties were probed by the surface magneto-optic Kerr effect (SMOKE) technique in a longitudinal geometry whereas morphology and crystallographic structure were determined respectively by STM and surface EXAFS. The Kerr experiments show an in-plane uniaxial anisotropy favouring magnetisation parallel to the step edges. The anisotropy constants were derived from the hard axes curves, using the model proposed in [1] which takes into account the influence of the external field on the spin reorientation. We found that the strength of the uniaxial anisotropy is larger on the substrate with smaller terraces and varies with film thickness (see fig. 1). The STM experiments show an important evolution of the morphology with the deposited quantity of cobalt. At the very beginning of the growth, the step array is profoundly altered, indicating that the presence of the steps increases the surface mobility of the copper atoms. At higher coverages, islands are observed on the surface. Around 5 ML the islands coalesce and relatively straight steps are again observed. Surface EXAFS experiments allow the measurements of cobalt lattice parameters in all crystallographic directions. We show that from 3 ML of cobalt on Cu(1 1 11) and 5 ML on Cu(115), the structure is nearly the same as on flat Cu(001) (a face centered tetragonal structure), which shows that the presence of narrow terraces does not induce any structural anisotropy in the (001) plane. Thanks to STM and EXAFS experiments, we can propose an interpretation of the uniaxial anisotropy. It is currently believed to arise from missing bonds at step edges (Néel-type anisotropy [2]) and/or strain in the film (magnetoelastic anisotropy [3]) but without any clear evidence. We have simulated the uniaxial anisotropy taking into account the missing bonds at the step edges determined by STM within the Néel model, and evaluated the magnetoelastic contribution induced by the crystallographic distortion measured by EXAFS. Moreover we estimate the dipolar anisotropy on this system. With these models, we can explain the uniaxial anisotropy and its variation with thickness. From our results, it appears that it is mainly due to the film morphology and that the contribution of the structural distortion is small.

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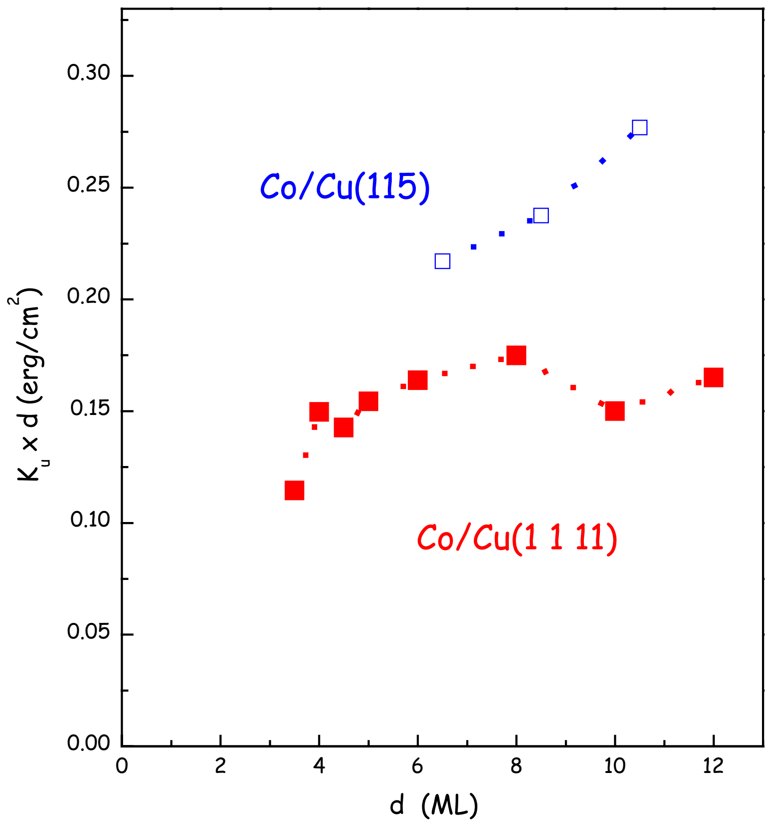


**Fig1** : Experimental values of the uniaxial anisotropy constants ($K_u$) multiplied by the Co film thickness d as a function of d