ESRF	Experiment title: **Characterization of self assembled monatomic Co wires probed by soft x-ray resonant magnetic scattering**	**Experiment number**: **HE-1748**
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Report:

Introduction

Low-dimensional systems, like ultrathin films and superlattices, displays distinctly different magnetic properties from those of bulk materials. It was, for instance, predicted early that in one or two dimensions long-range magnetic order is forbidden, i.e. it should become unstable against thermally induced spin fluctuations [1]. Such systems are particularly appealing since one-dimensional models are very useful in analyzing the interplay between finite size effects and electronic interactions, such as exchange and spin-orbit coupling. Since such properties depend on the size and shape of the system under investigation, sophisticated techniques have been developed to grow tailored structures. Among these, self-organization [2-4] offers the opportunity to create nanoscale patterns with densities as high as 10^{11-13} cm^{-2} in a fast parallel process. High densities are mandatory for the employment of integral probes to characterize the physical properties of nanoscale systems. The trade-off with respect to other patterning techniques such as e-beam or scanning probe writing is, of course, a limited choice of the available patterns and a finite width of the size distribution of the self-organized structures. Among self-organization techniques, step decoration on periodically stepped substrates can be used to grow arrays of nanowires [5].

Experiment & Results

The experiments were performed at the beamline ID8 using the high-field superconducting magnet. The Pt(997) crystal was cleaned *in-situ*. The quality of the surface was controlled with LEED and STM, as shown in (Fig. 1). The Co wire growth was controlled with soft X-ray resonant magnetic scattering with the X-ray incidence direction oriented perpendicular to the steps. The scattering signal was measured with a photodiode mounted on a vertical translation arm. The schematics of the experiment is shown in the inset of Fig. 2. Typical SXRMS scans are shown on the Fig. 2 with the specular peak clearly visible. From the FWHM we can extract a wire length scale of 25nm. The solid line corresponds to the clean Pt(997) surface and the dashed line with dots to a Co coverage of 0.4ML. Small increase of the width of the specular peak implies a slightly rougher surface after Co has been evaporated. This corresponds to the growth of well ordered Co wires.

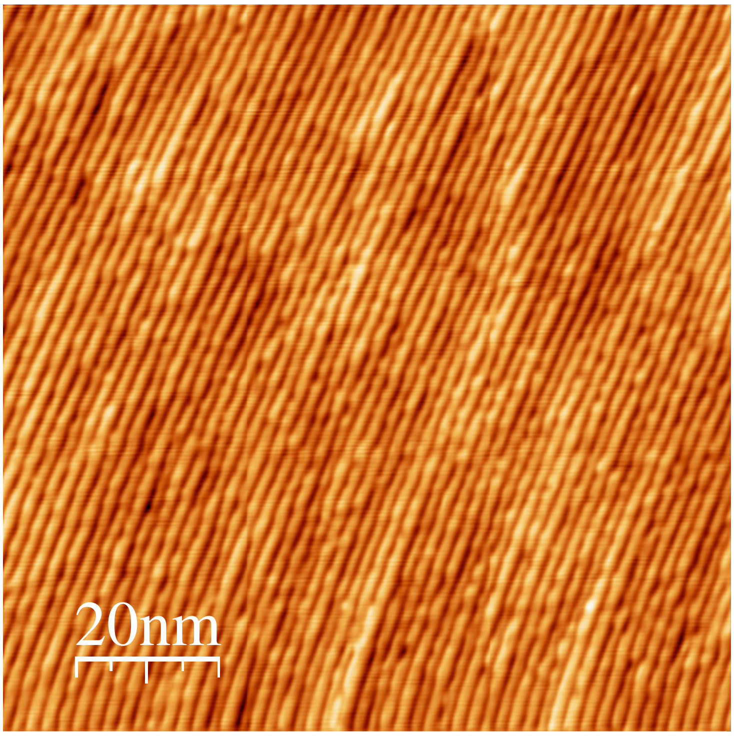

Fig. 1: STM image of the clean sample Pt(997) with terraces separated by monoatomic steps clearly visible

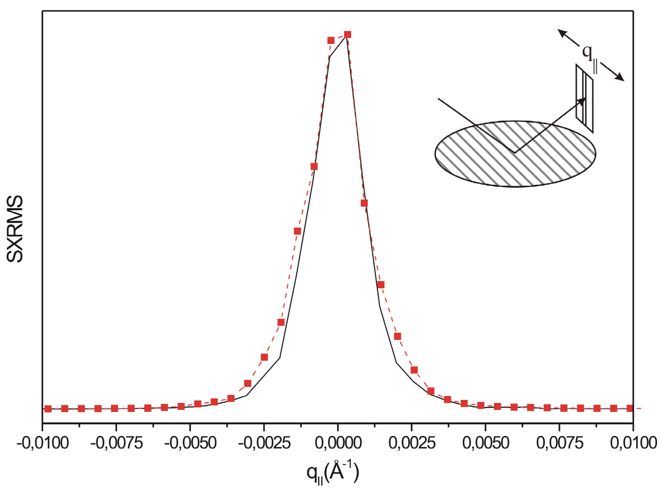

Fig. 2: Soft X-Ray resonant magnetic scattering (SXRMS) of clean Pt(997) (solid line) and Pt(997) covered with 0.4 ML of Co (dashed line with dots). The X-ray incidence angle was set to 20°. The mesured wave vector projected onto the surface, $q_{||}$, was varied along the step edges. The inset shows a schematics of the experimental setup. Lines indicates the step orientation.

Outlook

In the future we would like to use soft x-ray resonant magnetic scattering to measure magnetic properties. The diffuse scattering yield has been shown to be very sensitive to the magnetic domain configuration of a thin film sample [6] and can also be used to probe the spatial distribution of magnetic order in one-dimensional magnetic systems.

References

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