ESRF	**Experiment title:** **Formation and dynamics of self-organized nanostructures**	**Experiment number**: SI784
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Shifts: 27	**Local contact(s)**: Dr. Federico Zontone	*Received at ESRF:*

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Report:

This report concerns the first experiment of a Long Term Project (Exp. N° SI 784) approved by the Committee in the 2001/II round. The Committee approved the LPT for one year, allocating beam time for a test experiment on ID10A and a second run on ID3 . This second run will be done in 2002/II.

The test experiment on ID10A was devoted to the study of the formation of ripple morphology on Rh(110) by ion sputtering. This experiment continues a series that the proposer group performed in last years on the beam line ID3 (see reports on SI489 , SI594 and SI717 experiments).

The main difference of this experiment with respect to the previous ones was the use of coherent radiation. The goal was to observe in real time the evolution of the diffraction pattern and to get information on the temporal evolution of the nanostructures induced during the sputtering.

To perform the experiment, we constructed an experimental UHV chamber to fit with the beam line set-up. The chamber has a sample holder which allows to heat the sample up to about 1000 K. Two ion guns can be accommodated at the same time. Several ports are present to insert pressure gauges, evaporators and other experimental facilities. Polished Be windows with a lrge solid angle have been developed. The experimental chamber might be used other users, as indicated in our LTP proposal.

A single crystal of Rh(110) was inserted in the chamber and after many cleaning cycles it was sputtered with Argon. The parameter of the ion sputtering procedure were: ion current on the sample in the range 2.5 – 4 μA; angle of incidence of the ions 30° respect to the normal; ion energy 1 keV. The experiment has been done at different temperatures in the range 320 – 560 K .

The diffracted beam was recorded by a CCD camera, with a typical integration time of 20 sec.

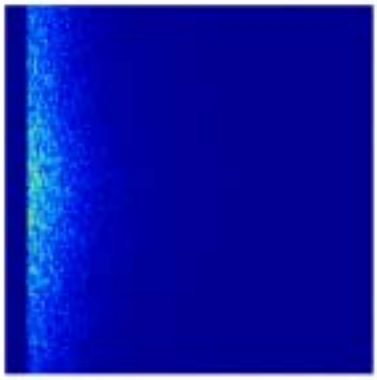

Fig. 1

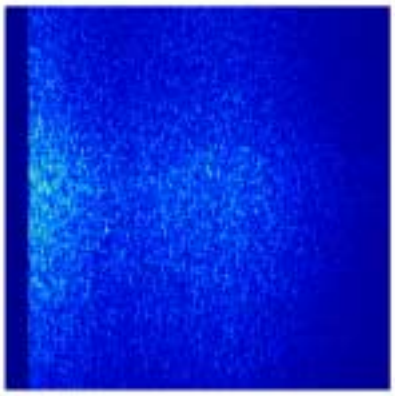

Fig. 2

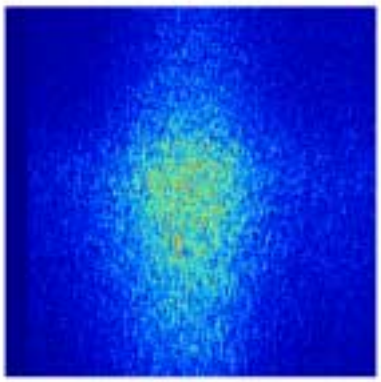

Fig. 3

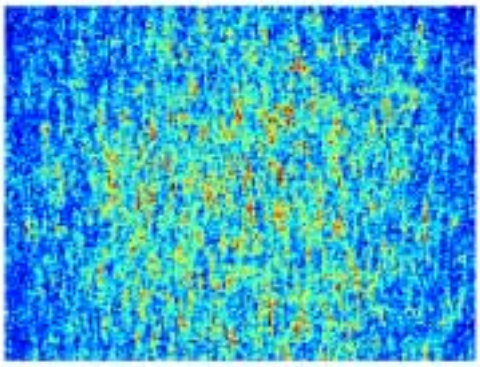

Fig. 4

In fig.1, we report a typical image acquired at the beginning of the sputtering procedure:
on the left side, a beam stopper prevents from the CCD camera saturation induced by the direct beam.

After 10 min of sputtering at 560 K, a shoulder appears on the right side respect to the direct beam (Fig.2):

After about 40 min, the shoulder is well developed (Fig.3); zooming inside, we can recognize that the shoulder is formed by many spots, elongated along the vertical direction. Each spot represents a speckle, due to the coherence of the X-ray beam, having a shape reflecting the geometry of the sample (Fig.4).

Presently, we are in the process of analyzing the data. In particular, we are studying the time correlation of a single speckle in order to get information about the development of the ripple on the surface.
Comparing these data with the previous ones acquired at ID3 with an incoherent beam (report SI717), we note that the shoulder appears much more structured and better defined. The spectra acquired on ID3 are the convolution of all the speckles observed on ID10A. However, we note that on ID3 it is possible to combine the GISAXS measurements with the CTR results, obtaining a detailed description of the nanostructures.
The results presented in this report demonstrates unequivocally that it is possible to follow the nanostructurization in real time with a coherent beam, as requested by the committee in the approval of our LTP.

A more detailed analysis will be described in a future report.