ESRF	**Experiment title**: Study of formation of self-organized linear nanostructures on Cu(110) formed during homoepitaxial growth and sputtering	**Experiment number**: SI-594
Beamline: ID 3	**Date of experiment**: from: 31 Jan 01 to: 08 Feb 01	**Date of report**: 28 Feb 01
Shifts: 21	**Local contact(s)**: Dr. Salvador Ferre	*Received at ESRF:*

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Report:

During the experiment SI - 594 we studied the development of self-organized structures on Cu(110).
At the moment, we report only on data obtained by ion sputtering, while those obtained by depositing Cu are still in course of analisys.

From other experiments (STM and SPa-LEED) carried out in our laboratory in Genova, we know that it is possible to nanopattern the Cu(110) surface by using ion sputtering; changing temperature and ion flux, we can obtain different regularly spaced structures: at low T (< 230 K) ripples aligned along the (100) surface direction and at high T (>300 K) ripples aligned along the (1-10) surface direction. At intermediate T, rectangular mounds are formed.

However, it is difficult to measure the time evolution of these structures in real-time, since both techniques we used do not allow to measure surface morphology during the sputtering process. For this reason, we performed this experiment at ESRF, at the ID3 beamline.

After preparing the Cu(110) surface with several cycles of ion sputtering and annealing, and after tuning the diffraction geometry, we started with the experiment, in which we measured the diffraction spectra at a fixed point of the surface truncation rod as function of time of sputtering, or the reflectivity in GISAXS geometry, again as function of sputtering time. From the diffraction spectra we learn abot the local slope of the facets induced by the sputtering process, while from GISAXS we derive the spatial periodicity of the nanostructures.

The main results we obtained during the experiment are:

- the local slope changes in time, following a simple power law with an exponent depending on the temperature and on surface direction (see Fig.1 and Fig.2). In some cases, there is a pronounced slope selection, already from the early stages of the sputtering process. After a long sputtering time, all measured slopes seem to converge in a restricted range between 8 and 10 degree.
- the spatial periodicity increases in time following a power law, with an exponent depending on temperature and surface direction (see Fig.3 and Fig.4). For a fixed direction, the exponent decreases with temperature, while the absolute value of the periodicty is larger at high temperature.
- an asimmetry in the local slope is evident, in the sense that the two satellites peaks in the diffraction spectra are not fully simmetric respect to the central peak. That is an indication of the influence of the ion beam which does not impinge in a simmetric way on the nanostructures. It is still unclear if this effect is due to a geometric shadowing or to a different energy deposition on the two sides of the ripples or mounds.

At end, we measured the time evolution ot the surface truncation rod (at a fixed point) also with a CCD camera. Three snapshots of the film are presented in Fig.5

Figure captions:

Fig.1 and Fig.2 : time evolution of the local slope along the H and K directions, corresponding to the (100) and (1-10) surface directions, respectively.

Fig.3 and Fig.4 : time evolution of the spatial periodicity along the H and K directions, corresponding to the (100) and (1-10) surface directions, respectively.

Fig.5 : three snapshots taken at different time with the CCD camera

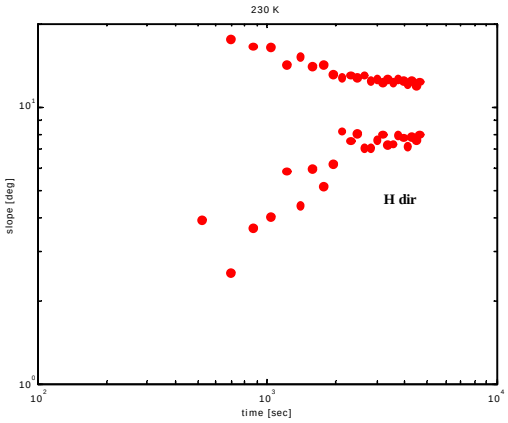

Fig.1

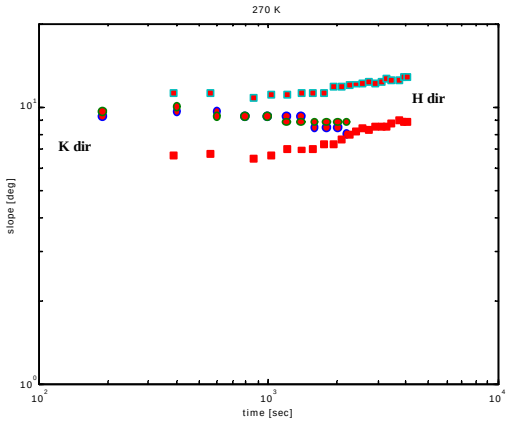

Fig.2

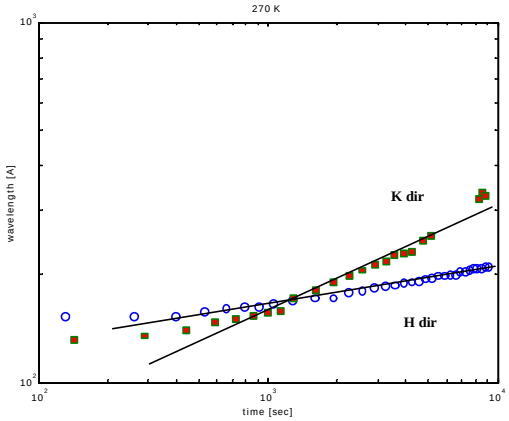

Fig.3

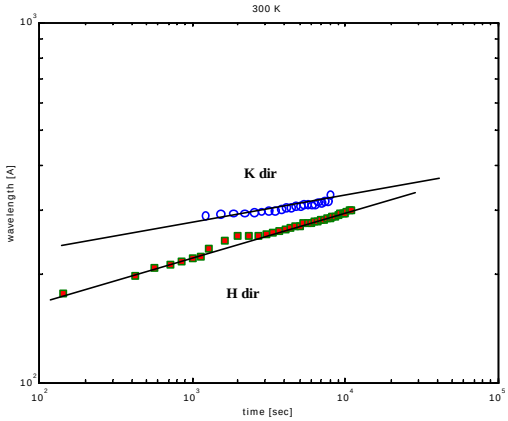

Fig.4

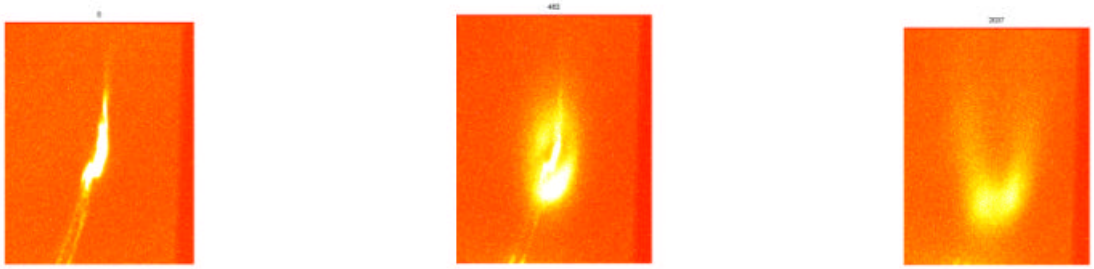

Fig.5