EUROPEAN SYNCHROTRON RADIATION FACILITY
INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

	Experiment title: **Ordering and kinetics of Ag-induced nanofaceting of Cu vicinal surfaces**	**Experiment number**: SI 1002
Beamline: ID03	**Date of experiment**: from: 13 July 2004 to: 19 July 2004	**Date of report**: 31 August 2004
Shifts: 21	**Local contact(s)**: Dr. Odile Robach	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Dr Alessandro COATI * - LURE – Orsay – France
Dr Jerome CREUZE – LEHME - Orsay – France
Dr. Yves GARREAU * - LURE – Orsay – France
Dr. Michèle SAUVAGE-SIMKIN * - SYNCHROTRON SOLEIL – St. Aubin - France

Report:

The self-organisation of nanometric systems has been intensively studied in the last years [1] due to their potential application for the fabrication of magnetic, optoelectronic or catalytic nano-objects among others. The faceted surfaces represent a promising way for the realisation of nanostructured templates. Recently A. Bachmann et al. [2] observed a periodic faceting of Cu vicinal surfaces induced by the deposition of Ag atoms in the sub-monolayer regime.

We have performed a series of experiments on ID03 beamline at ESRF in July 2004 (exp. SI 1002), using Grazing Incidence X-Ray Diffraxtion (GIXD). Durning the 21 allocated shifts we studied the faceting process of the Cu vicinal surface after Ag deposition. The present report concerns the results obtained on the Cu(322) surface, the data analysis and reduction is under work at the present moment.

The deposition of Ag atoms on a Cu vicinal surface induces the formation of a striped system, with an alternated succession of bare Cu and Ag covered facets. The hill to valley structure obtained in this way is periodic and the period varies in the 10^{th} of nanometer regime.

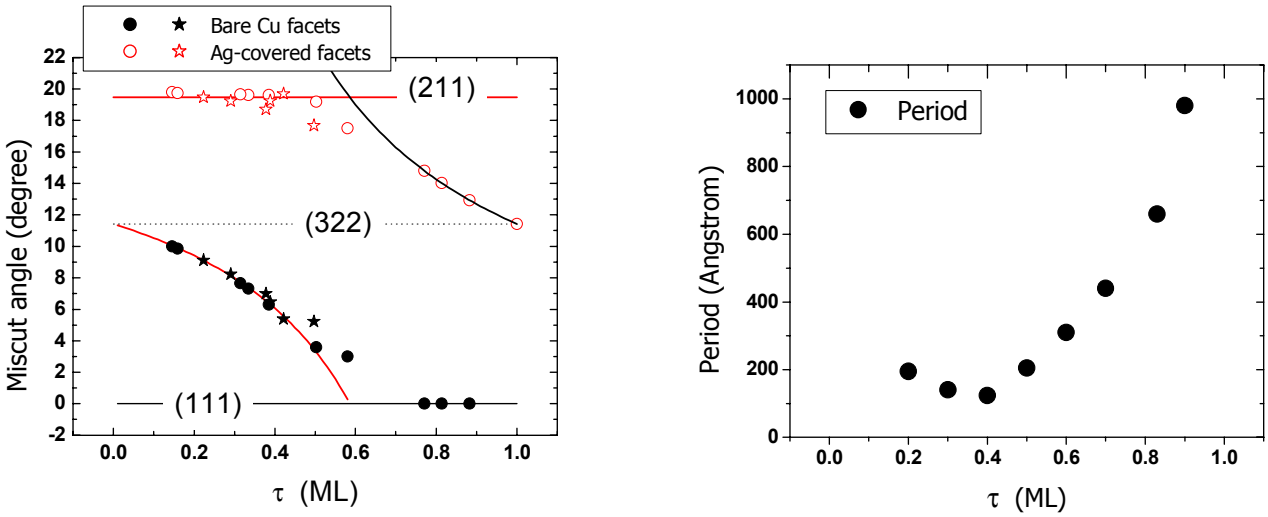
At the beginnings we were interest in the study of the faceting of the Cu(433) surface. Unfortunately, an unexpected technical problem due to the broken of the power supply of the sample heater produced the melting of our sample (and the lost of 6 runs). For this reason we decided to study the Cu(322) surface, which was previously investigated at the LURE-DW12 beamline. The performed experiments have given a series of new and interesting results, which allow us a deeper comprehension of the system evolution.

First of all we reproduce nicely the results obtained at LURE, with a higher resolution and a higher signal/background ratio. We have obtained the evolution of the facets as a function of the Ag coverage, as shown in Fig.1. In the figure we compare the miscut angles of the facets respect to the (111) planes. In the figure the data collected at ESRF (circles) are compared to those collected at LURE (stars), the data show a good agreement. Nevertheless, the new data acquired at ESRF concerns a larger deposition coverage range,

permitting a very fine description of the evolution. As shown, there are two regimes: for low coverages the Ag covered facets are constituted by (211) planes and the bare Cu facets change their miscuts in order to keep the average surface miscut constant. For high coverages the bare Cu facets are constituted by (111) planes, while the Ag covered facets change. The continous lines represent the miscut calculated using the relationship between the miscut and the coverage and assuming that the average surface miscut is constant.

In Fig.2 we show the period versus the coverage. Thanks to the high brillance and to the high resolution of ID03 we were able to measure the period in all the deposition range explored. These results are completely new and we were not able to measure them at LURE. The measured periods are relevant for the study of the self-organisation of the system. Marchenko [3] developed a model to explain the self-organisation of systems with two phases, based on the elastic relaxations induced in the substrate. On other systems the Marchenko model explains very well the organisation and predicts the evolution of the period as a function of the coverage. In the Fig.2 we can see that the minimum of the period is obtained for a coverage of about 0.4 Ag monolayers, and not for 0.5 ML, as predicted by Marchenko. An interesting task for our future work will be to understand this evolution and to extract the intensity of the elastic forces of the organisation, as we have done for the case of the system N/Cu(100) [4].

Finally, we collected a series of diffracted rods for the structural study of one facet covered by Ag. For a coverage of about 0.7 ML we obtained well defined Ag-covered (533) facets. These facets present a surface reconstruction, which we studied collecting a series of 10 rods. The aim of these measurements is to compare them to the data collected at LURE on the surface reconstruction of the Cu(211) Ag covered facets, which we completely solved in the past, using GIXD and complementary quenched molecular dynamic simulations [5].



The experiments performed during the allocated shifts will allow us a deeper comprehension of the self-organisation of our system. Unfortunately, due to the unexpected technical problems at the beginnings of the experiment we were not able to study in details the early stages of the facet formation and their kinetical evolution, as planned in the original proposal. Nevertheless, the high resolution of ID03 has permitted to obtain new and original results on the system, between them the period evolution as a function of the coverage (Fig.2).

References

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