Experiment Report Form

The double page inside this form is to be filled in for each experiment at the Rossendorf Beamline (ROBL). This double-page report will be reduced to a one page, A4 format, to be published in the Bi-Annual Report of the beamline. The report may also be published on the Web-pages of the FZD. If necessary, you may ask for an appropriate delay between report submission and publication.

Should you wish to make more general comments on the experiment, enclose these on a separate sheet, and send both the Report and comments to the ROBL team.

Published papers

All users must give proper credit to ROBL staff members and the ESRF facilities used for achieving the results being published. Further, users are obliged to send to ROBL the complete reference and abstract of papers published in peer-reviewed media.

Deadlines for submission of Experimental Report

Reports shall be submitted not later than 6 month after the experiment.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the reference number of the proposal / experiment to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.
- bear in mind that the double-page report will be reduced to 71% of its original size, A4 format. A type-face such as "Times" or "Arial" , 14 points, with a 1.5 line spacing between lines for the text produces a report which can be read easily.

Note that requests for further beam time must always be accompanied by a report on previous measurements.

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ROBL-CRG	**Experiment title:** GISAXS study of self organized metallic islands and nanowires on rippled substrates	**Experiment number**: **20-02-676**
Beamline: BM 20	**Date of experiment**: from: 01/07/2009 to: 05/07/2009	**Date of report**: 06/11/2009
Shifts:	**Local contact(s)**: Nicole Jeutter	*Received at ROBL:*

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Report:

Self-organization of Ag nanoparticles on ion beam pre-patterned Si surfaces has been investigated by means of grazing incidence small angle x-ray scattering (GISAXS). The periodic surface roughness undulations have been prepared by oblique incidence ion beam sputtering. Figure 1 shows the atomic force surface image and the corresponding 2D GISAXS image recoreded with the x-ray beam direction parrallel to the ripples. Two streaks in the GISAXS pattern are observed. Position of their maximum on the scattering vector q_y axis is inversely proportional to the ripple

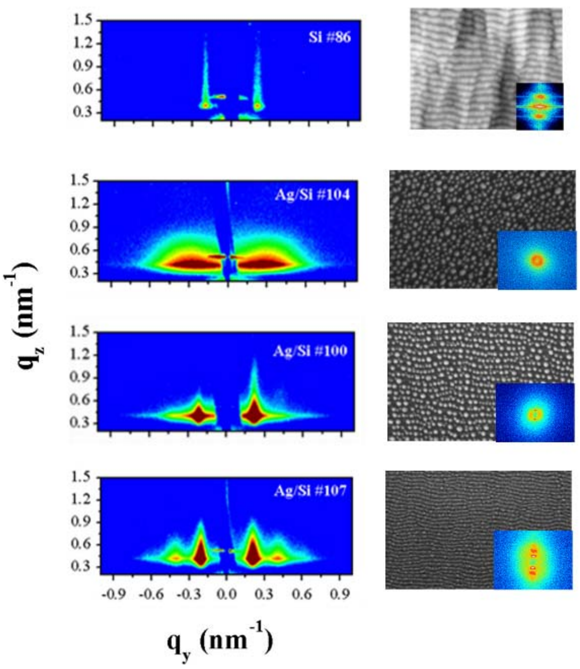

Figure 1. 2D GISAXS images (left column) and correspondind surface micrographs (right column) with their fast fourier transforms (insets) of the Si surface with ripples (first row), Ag nanoparticles on non-patterned Si surface (second row), Ag nanoparticles (third row) and Ag nanowires (fourth row) on ion beam pre-patterned Si surfaces.

period which is ~31 nm. Left streak shows higher intensity than the right one reflecting the assymetric cross-sectional ripple shape [1].

When Ag thin film is grown on the pre-patterned surface by physical vapour deposition, alligned nanoparticle or nanowire arrays are obtained depending on the growth conditions (see scanning electron microscopy micrographs in Figure 1). These morphologies are reflected in corresponding GISAXS patterns (see Figure 1) which show strong intensity streaks suggesting strong correlations in the direction perpendicular to the ripples. The presence of a 2nd peak (and 3rd order peak for the nanowires) points out the paracrystalline ordering [1,2]. Ag nanoparticles grown on non-prepatterned Si surfaces show two broad intensity lobes (see Figure 1) suggesting rather diffuse spatial correlations. This underlines the influence of the pre-patterning on the Ag nanoparticle growth thermodynamics and/or kinetics [4]. Note, that the streak assymetry intensity of aligned Ag nanoparticle GISAXS is inversed in relation to that of the underlying Si ripples. This is most probalby related to the growth of Ag nanoparticles on the ripple slope and their oblate (or prolate) shape. The understanding of such behaviour needs further studies.

In-situ experiments of the de-wetting of thin obliquely deposited Ni films on pre-patterned substrates could not be carried out due to technical problems related with the sample re-alignement which is needed after each heating step. However, preliminarly results indicate that thin Ni films show correlated roughness with the underlying Si ripple pattern while upon heating splitting occurs in the temperature range of ~400-500°C. The de-wetted film shows signatures of correlated nanoparticle arrays similar to those observed for the ex-situ grown Ag films.

1. D. Carbone, A. Biermanns, B. Ziberi, F. Frost, O. Plantevin, U. Pietsch and T. H. Metzger, J. Phys.: Condens. Matter **21**, 224007 (2009).

2. R. Lazzari, J. Appl. Cryst. **35**, 406 (2002)

3. R. Lazzari, F. Leroy, G. Renaud, Phys. Rev. B **76**, 125411 (2007).

4. T.W.H. Oates, A. Keller, S. Facsko, A. Muecklich, Plasmonics, **2**, 47 (2007).