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Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

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Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

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 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.

ESRF	**Experiment title:** Anomalous X-ray diffraction from SiGe Domes on Si(001)	**Experiment number**: Si-871
Beamline: ID01	**Date of experiment**: from: 18.06.2003 to: 24.06.2003	**Date of report**: 29.08.2003
Shifts: 18	**Local contact(s)**: Tobias Schülli	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

T. U. Schülli*[1,2], R. T. Lechner*[2], E. Wintersberger*[2], J. Stangl[2], G. Bauer[2], T. H. Metzger*[1]

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Report:

Anomalous x-ray diffraction at high momentum transfer and reciprocal space mapping has been employed to study the compositional evolution in SiGe domes on Si(001). The SiGe islands were grown via MBE deposition of pure Ge on Si(001) at various temperatures. The high momentum transfer significantly enhances the resolution in composition and strain and therefore supplies a tool to describe gradients in reciprocal space [1]. The determination of the concentration is based on a precise knowledge of the atomic scattering factors. A complementary x-ray technique to determine concentration profiles in epitaxial nanostructures is supplied by x-ray reciprocal space mapping. Here, the composition is determined via the elastic response of the alloy to the epitaxial stresses. The reults rely on the knowledge of the elastic constants for SiGe alloys and are not sensitive to the atomic scattering factors. We determined the composition in a series of samples by grazing incidence anomalous diffraction and compared the results with the reciprocal space maps of the same samples. The results for both methods coincide well and confirm the existence of a well-defined interface between the SiGe domes and the Si-substrate. The increase in growth temperature leads to an increase of the Si-content and an increase of the concentration gradient inside the domes, without affecting the unblurred interface. Figure 1 (a) shows the results for the composition as a function of in-plane lattice parameter, determined by anomalous diffraction at the (800) in-plane reflection. In Fig. 1 (b), the reciprocal space maps for the (404) reflections are plotted. For pseudomorphic tetragonal distortion, the iso-composition lines are added for the minimum and maximum Ge-concentration as found inside the domes by anomalous diffraction. The diffuse intensity streaks origination from the islands lie indeed between those limits, however, an evaluation of the Ge content via reciprocal space mapping seems to underestimate the Ge content. The weak inclination of the intensity streaks with respect to the iso-composition lines confirms the rather poor evolution of the Ge-content throughout a wide lattice parameter distribution. Both methods confirm the importance of SiGe intermixing during deposition of pure Ge on Si (001) together with the conservation of a well-defined interface between the SiGe island and the Si-substrate.

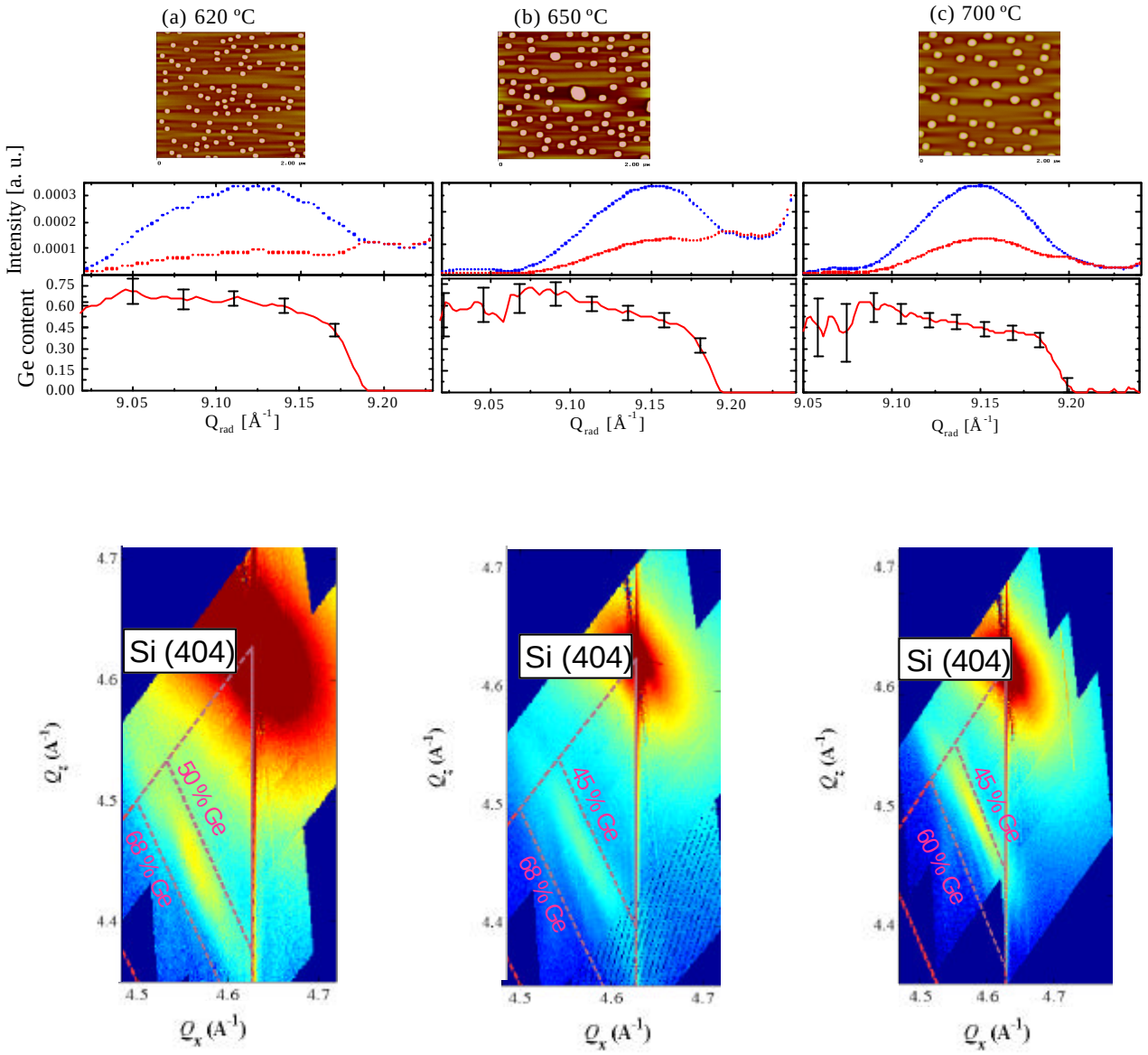

Fig.1: (a)-(c): SiGe domes grown by MBE deposition of pure Ge on Si(001) at different temperatures. Below the AFM images of each sample, the anomalous diffraction data for the (800) in-plane reflection is plotted for two energies, together with the Ge-concentration extracted from the data. Reciprocal space maps recorded by coplanar diffraction are presented for the (404) reflection for each sample. The lowest and the highest concentration as determined by anomalous diffraction are marked in the reciprocal space maps.

References

[1] T. U. Schülli, J. Stangl, Z. Zhong, R. T. Lechner, M. Sztucki, T. H. Metzger, G. Bauer, Phys. Rev. Lett. **90**, 066105 (2003).