EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

# 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 via the User Portal:

*https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do*

***Reports supporting requests for additional beam time***

Reports can 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.

***Published papers***

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

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:** XRF and XAS characterization of Ge1-xSnx micro-disks | **Experiment number:** MA-4363 |
|---|---|---|
| **Beamline:** ID16B | **Date of experiment:** from: 28/09/2018 to: 1/10/2018 | **Date of report:** 28/02/2020 |
| **Shifts:** 12 | **Local contact(s):** Jaime SEGURA-RUIZ | *Received at ESRF:* |

**Names and affiliations of applicants** (* indicates experimentalists):

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**Report:**

During the 12 shifts, 8 samples (three layers and six micro-disks) were characterized by XRF and XANES in order to elucidate the mechanism behind the appearance of Sn-segregation, and the best growth conditions to avoid this segregation. Table 1 summarizes the samples characterized during this experiment and their main characteristics.

| | Shape | Substrate | Top layer | |
|---|---|---|---|---|
| | | | Composition | Thickn. |
| 2 | Micro-disks | Nominal Ge Strain Relaxed Buffer (SRB) | $Ge_{0.933}Sn_{0.067}$<br>$Ge_{0.9}Sn_{0.1}$ | 200 nm<br>200 nm |
| 3 | | | $Ge_{0.905}Sn_{0.095}$<br>Transit layer<br>$Ge_{0.894}Sn_{0.116}$ | 120 nm<br>90 nm<br>220 nm |
| 4 | | | $Ge_{0.905}Sn_{0.095}$<br>Transit layer<br>$Ge_{0.894}Sn_{0.116}$ | 160 nm<br>60 nm<br>210 nm |
| 6 | | GeSn Step-graded Buffer (SGB) / Ge-SRB | $Ge_{0.937}Sn_{0.063}$<br>$Ge_{0.917}Sn_{0.083}$<br>$Ge_{0.889}Sn_{0.111}$ | 120 nm<br>120 nm<br>240 nm |
| 7 | | | $Ge_{0.922}Sn_{0.078}$<br>$Ge_{0.905}Sn_{0.095}$<br>$Ge_{0.875}Sn_{0.125}$<br>$Ge_{0.84}Sn_{0.16}$ | 120 nm<br>112 nm<br>108 nm<br>180 nm |
| 8 | Pseudo-morphic layers | Nominal Ge Strain Relaxed Buffer (SRB) | $Ge_{0.9}Sn_{0.1}$ | 59 nm |
| 9 | | | $Ge_{0.87}Sn_{0.13}$ | 54 nm |
| 10 | | | $Ge_{0.84}Sn_{0.16}$ | 31 nm |

**Table 1**. List of samples characterized duirng the experiment Ma-4363 and their characteristics.

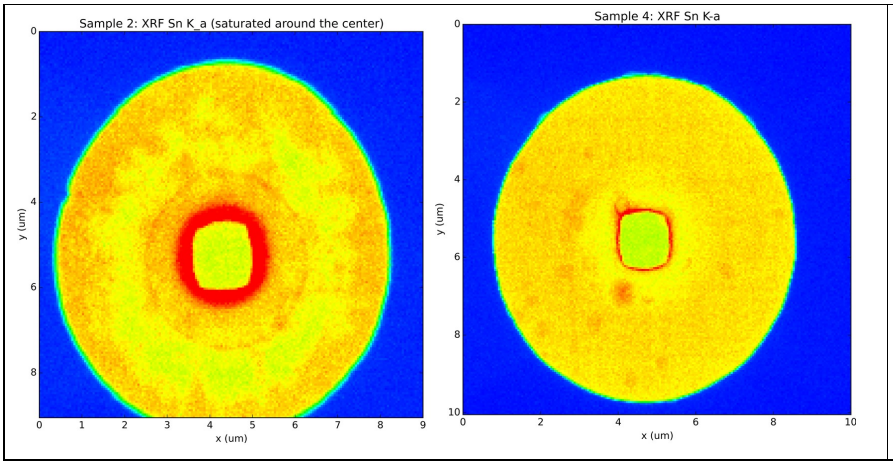


**Figure 2.** XRF maps of two micro-disks showing the Sn distribution along the entire disks. The pattern observed in the sample 2 (left) compared with the flat distribution observed in sample 4 (rigth) is considered to be produced by the etching process removing more material in samples with lower Sn-content.

Two representative XRF maps are displayed in the Figure 1. It can be observed that the Sn shows a patterned and a flat distribution in the sample with thte lower and higher Sn-concentration, respectively. This is considered to be produced by the etching process removing more Ge in samples with lower Sn-content than in those with a higher one.

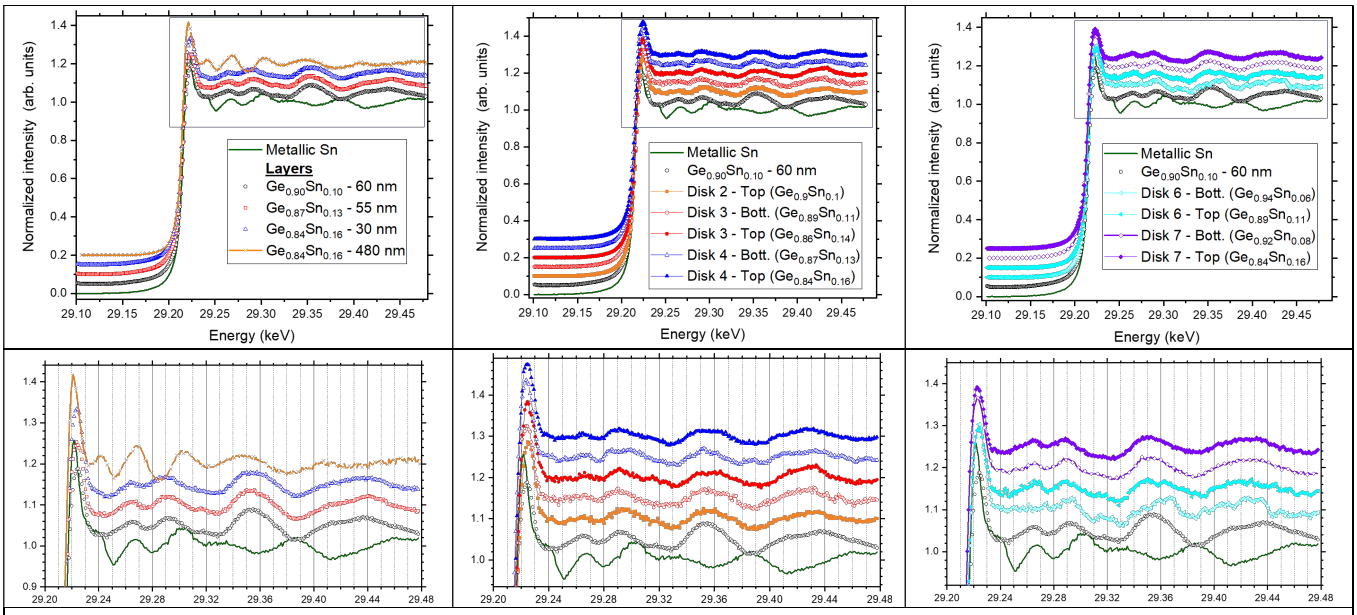


**Figure 2.** XANES spectra (full - upper panel; detail lower panel) of the entire set of samples characterized. Pseudomorphic layers compared with the metallic Sn XANES spectrum (left panel); microdisks grown direclty on strain relaxed buffer (SRB) compared with metallic and pseudomorphic layer (central panel), and microdisks grown direclty on step-graded buffer (SGB) compared with metallic and pseudomorphic layer (rigth panel).

Figure 2 shows the XANES spectra of the entire set of samples characterized. It can be observed that micro-disks grown on SGB show a better quality than those grown direclty on SRB. Furthermore, it seems that having more steps in the SGB improves the quality of the top layer even if this has a higher Sn-content.

**Publications**: One paper will be sumbitted soon reporting the main results obtained from this experiment.