EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

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

Deadlines for submission of Experimental Reports

Experimental reports must be submitted within the period of 3 months after the end of the experiment.

Experiment Report supporting a new proposal ("relevant report")

If you are submitting a proposal for a new project, or to continue a project for which you have previously been allocated beam time, you must submit a report on each of your previous measurement(s):

- even on those carried out close to the proposal submission deadline (it can be a *"preliminary report"),*
- even for experiments whose scientific area is different form the scientific area of the new proposal,
- carried out on CRG beamlines.

You must then register the report(s) as "relevant report(s)" in the new application form for beam time.

Deadlines for submitting a report supporting a new proposal

- 1st March Proposal Round - **5th March**
- 10th September Proposal Round - **13th September**

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.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the experiment number 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.

	Experiment title: XRD and XRF Characterization of InAs Nanowires Grown on GaAs Membranes	Experiment number: MA-4446
Beamline: ID16B	Date of experiment: from: 08.10.2020 to: 11/10/2020	Date of report: 10/03/2021
Shifts: 9	Local contact(s): Jaime Segura Ruiz	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

DEDE Didem, PIAZZA Valerio, MORGAN Nicholas, BALGARKASHI Akshay, FONTCUBERTA I MORRAL Anna

Report:

During the 9 shifts, 4 samples (14 different regions) were characterized by XRF in order to understand the uniformity along the nanowires and nanomembrane junctions. Table 1 summarizes the samples characterized during this experiment and their main characteristics.

Sample ID	Substrate orientation	Geometry	
D1-20-08-12-A	100	20/1/20 50/1/20	InAs NWs on GaAs NMs Along <110>
D1-20-08-13-C	100	140/1/20 50/1/20 20/1/20	InAs NWs on GaAs NMs Along <100>
D1-20-08-18-C	110	120/1/20 60/1/20	InAs NWs on GaAs NMs Along <111>
D1-20-07-06-C	100	4 different junctions examined	GaAsSb NM jucntions

Table 1: List of samples and their characteristics that are characterized during the experiment MA-4446 in ID16B. In the geometry part, numbers correspond to nominal width/ nominal pitch/ length of the slits

In our experiments, Cu filter was used to diminish the emission coming from the substrate. Therefore, we couldn’t make direct correlation between the chemical composition and the XRF intensity from In and Sb species. However, it gave us an idea on the uniformity along long regions

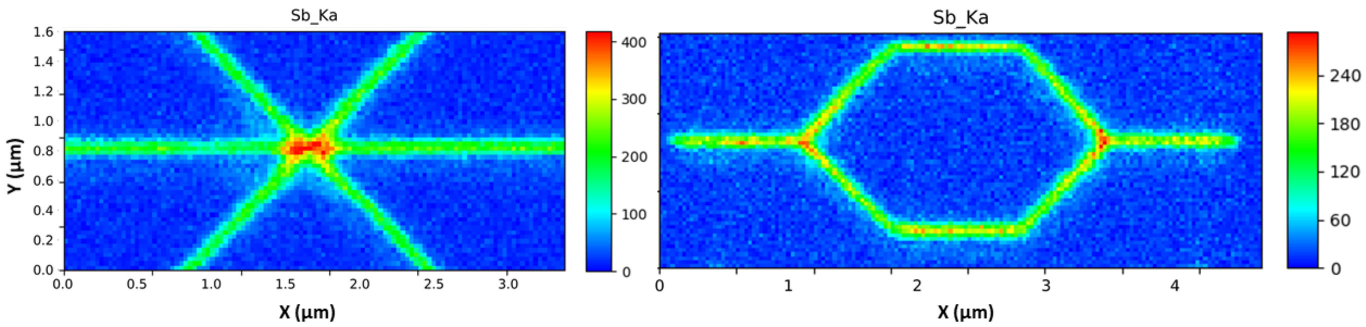

Figure 1: XRF Sb-Ka maps of GaAsSb nanomembrane junctions. The orientation of nanomembranes while forming junctions is significant.

Two representative XRF maps from GaAsSb nanomembranes (NMs) are shown in Figure 1. It can be observed that at the junction where membranes unite, there is an increase in the Sb concentration. This is mostly as a result of overgrowth, since more material accumulates at the junction during growth. This is also present in our SEM images. During GaAsSb growth, we used 10% of As partial pressure as Sb pressure which we obtained the most uniform structures. However, we believe this corresponds to less than 10% atomic percent present in the structures.

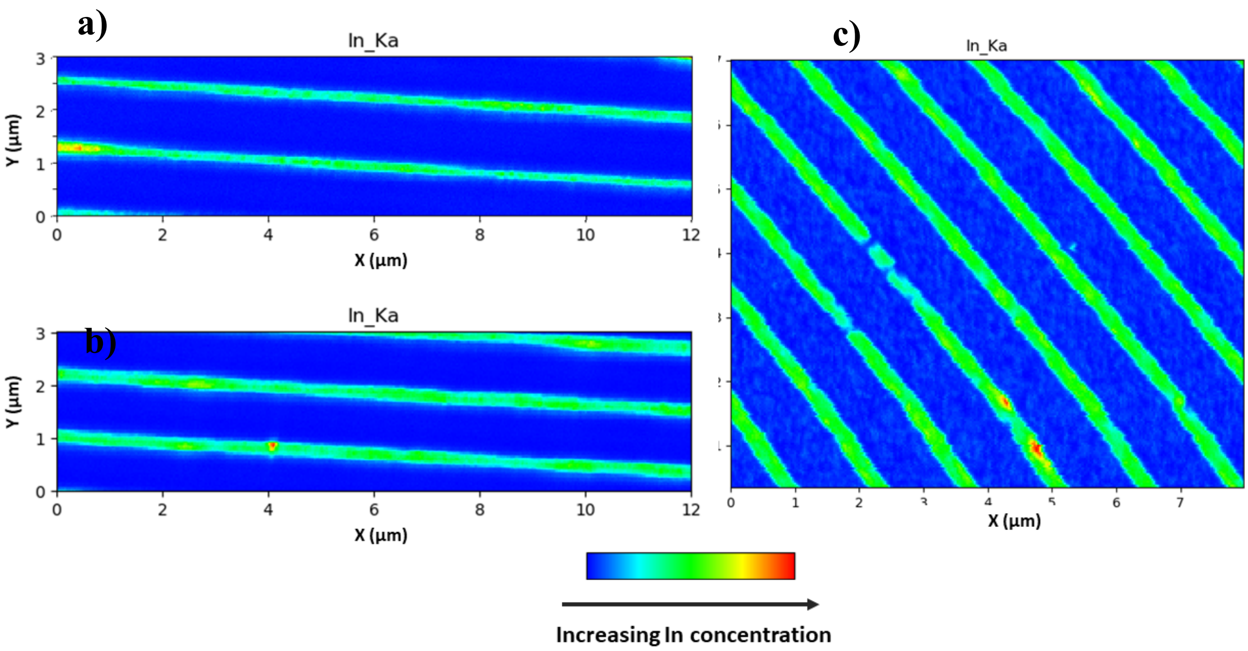

Figure 2:XRF In-Ka maps taken from InAs NWs grown on (100) GaAs NMs. NWs along <110> having 1 um nominal pitch a)20 nm nominal width b) 50 nm nominal width. c) NWs along 100 direciton having 140 nm nominal width and 1um nominal pitch

Depending on the crystal direction, uniformity of In changes. Figure 2 summarizes InAs nanowire (NW) samples along 2 different orientation. Structures along <110> family direction looks more uniform in terms of concentration than the NWs grown along <100>. In sumamry, XRF mapping on ID16B allowed us to study the uniformity in the Sb and In incorporation into the GaAs membranes and InAs nanowires, respectively. This results will be used to optimize the growth conditions looking to obtain homogeneous InAs nanowires for application in quantum computing.