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

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.

ESRF	**Experiment title:** Organic/Inorganic Hybrid 2D Perovskites for Photovoltaic Applications Deposited in Vacuum	**Experiment number**: SC-5142
Beamline: ID10	**Date of experiment**: from: 06 May 2021 to: 10 May 2021	**Date of report**:
Shifts: 12	**Local contact(s)**: Oleg Konovalov, Maciej Jankowski	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Lena Merten*, Alexander Hinderhofer*, Frank Schreiber

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Report:

1. Abstract

Several series of hybrid orgainc/inorganic perovskite thin film samples were analyzed by GIWAXS during the beamtime. Those included different kinds of 2D perovskite structures as well as perovskite films produced by novel deposition techniques to obtain more uniform and phase-pure perovskite materials suitable for photovoltaic application.

2. Experimental Results

Shown in Figure 1 are reciprocal space maps of multiple cation perovskites fabricated via the well-established antisolvent method. A novel antisolvent application procedure was investigated, which significantly improved the film quality and photovoltaic performance. Figure 1a) corresponds to a perovskite film produced by the standard antisolvent procedure, exhibiting a considerable amount of excess lead iodide phase (indicated by the yellow arrow). In contrast, we could prove a distinct reduction of the excess lead iodide and therefore a higher perovskite phase purity in the sample produced with the new antisolvent application method, which is shown in Figure 1b). Also, by using GIWAXS with varying incidence angles, we could determine the distribution of the impurity phase throughout the perovskite film and with that information reveal the underlying mechanisms of structure formation depending on the fabrication method.

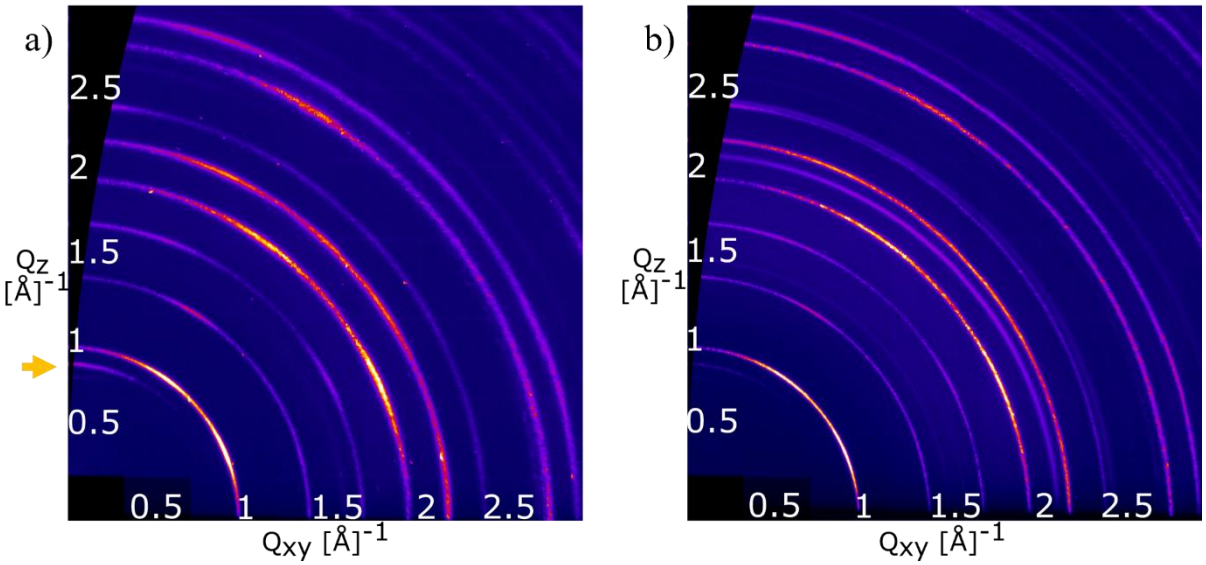

Figure 1: Reciprocal space maps of multi-cation perovskites fabricated with the antisolvent method using a) the conventional application procedure and b) a novel application method.

3. Remarks on quality of measurements

Due to the ongoing pandemic, the beamtime was conducted via mailing in the samples and the experiments were done by our local contacts. Thanks to their hard work and dedication we received an incredible amount of high-quality data. The ID10 beamline was perfectly suited to our experiments and using the pilatus 300K detector, we obtained excellent results.

We thank our local contacts Oleg Konovalov and Maciej Jankowski for the excellent work during the beamtime.

4. Status and progress of data evaluation

As a result of the large amount of data obtained from the beamtime, analysis is still in progress. We aim to include the data series in several publications once they are fully analyzed.