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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 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.

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:** Structure formation at the p-n interface of organic solar cells	**Experiment number**: SC 2571
Beamline: Id10b	**Date of experiment**: from: 18-02-2009 to: 24-02-2009	**Date of report**: 22-07-2009
Shifts: 18	**Local contact(s)**: Dr. Jiri Novak	*Received at ESRF:*

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

The experiments were performed along the lines of our proposal, focussing on *in situ* and real-time growth studies of organic molecules. Since the data analysis is still in progress, we can only report the most important findings.

Single layers

As described in the proposal, the first step in our experiment was the production and charakterization of thin films of the p-conductor diindenoperylene (DIP) on indium tin oxide (ITO) substrates.

Post-growth specular reflectivity data of three DIP films evaporated at different substrate temperatures are shown in Fig. 1. As expected the structural order and roughness exhibit a strong temperature dependence. Films grown at 300 K and 400 K show an out-of-plane lattice spacing of 1.65 nm corresponding to the DIP σ-phase, for which the DIP molecules are nearly upright standing on the substrate. The film grown at lower temperature (200 K) however shows no Bragg reflection in the q_z direction. The lower crystallinity of films grown at lower temperatures result in much lower surface roughness, which can be extracted from the Kiessig-oscillations in Fig. 1.

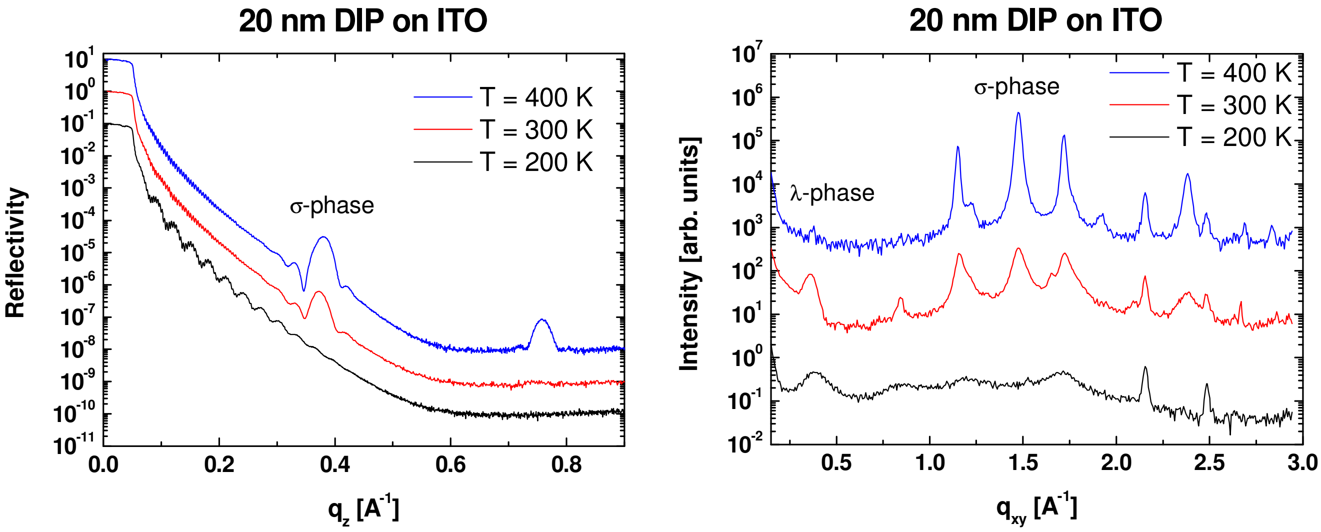

Fig. 1 ***Left:*** **Specular reflectivity of 20 nm DIP deposited on ITO at three different substrate temperatures.** ***Right:*** **Grazing incidence x-ray diffraction data from the DIP films.**

Additional grazing incidence x-ray diffraction (GIXD) scans shown in Fig.1 b reveal the in-plane structure and phase composition of the grown films.

Heterostructures

As a second step the organic n-type semiconductor perfluoropentacene (PFP) was evaporated at 300 K on top of the DIP layers to form an organic heterostructure. X-ray reflectivity and GIXD data from the completed heterstructures were measured. Since the out-of-plane lattice spacing of DIP (d = 1.65 nm) and PFP (d = 1.57 nm) differ only slightly, there specular Bragg reflections are superimposed.

One observation is that the intensity of the in-plane and out-of-plane Bragg reflections of PFP may be influenced due to the structure and morphology of the DIP underlayer.

In addition, for all growth runs real-time x-ray reflectivity data were measured from which the roughness evolution during film growth can be extracted.

In the future we will connect this interesting structural discoveries with photovoltaic electrical measurements of the grown heterostructures to probe how the structural properties of the pn-heterojunction will influence the transport properties and the photovoltaic efficiency.

We wish to acknowledge the excellent collaboration with the local contact Dr. J. Novak which made this challenging experiment a success.