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 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:** In-situ X-ray study of the growth and structure of p-n organic heterojunctions on SiO2	**Experiment number**: SI-1325
Beamline:	**Date of experiment**: from: 15/03/06 to: 22/03/06	**Date of report**: 31.08.2006
Shifts:	**Local contact(s)**: Dr. Leide CAVALCANTI	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

E. Barrena*[1,2], X.N. Zhang*[1],D. García de Oteyza*[1], O. Ossó*[2]

[1] Max-Planck-Institut für Metallforschung, 70569 Stuttgart, Germany
Universität Stuttgart. 70550 Stuttgart

[2] Institut de Ciència de Materials de Barcelona, CSIC, 08190 Bellaterra, Spain

Report:

The experiment SI-1325 was proposed to investigate the kinetic aspects of the growth and structure of organic heterostructures of organic semiconductors and was performed at ID10B. PTCDI-C8, among the few known n-type organic melecule, has been chosen as our candidate. Pentacene, the mostly used p-type semicoductor in industrie with highest carry mobility, has been used as second molecule to build the organic heterostures. The experiments revealed the formation of very well ordered bilayers of PTCDI and pentacene. Due the interest and success of these experiments, the investigation was extended to heterostructures of F_{16}CuPc and PTCDI.

We have performed in-situ and simultaneously X-ray Specular reflectometry and GIXD during the growth. Additionaly Real-time measurement of the intensity at 1/2 Bragg point Vs coverage have been performed.

1. PTCDI and pentacene heterostructures on Al_2O_3

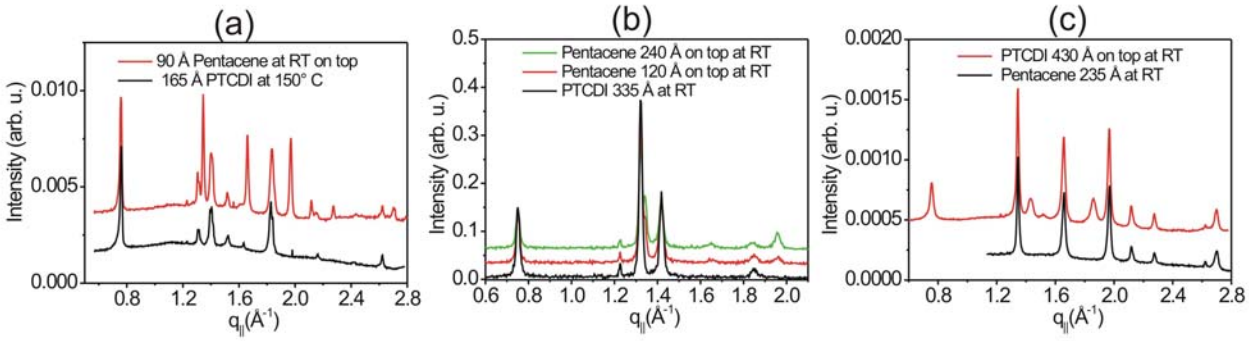

Fig. 1 GIXD data for heterostructures of PTCDI-C8 and pentacene.

The figure 1 shows in-situ GIXD measurements for the growth of heterostructures of pentacene and PTCDI-C8.

PTCDI-C8 films grown at 150ºC (figure 1a) and at room temperature (Figure 1b) have been grown as template layer. Pentacene films were deposited on top at room temperature.

When pentacene is deposited onto the PTCDI-C8 films, a smooth film ordered with the so-called *thin-film structure* is formed. By changing the deposition order, i.e. using pentacene as template layer, PTCDI-C8 shows worse ordering compared to that on Al_2O_3 , (see figure 1c).

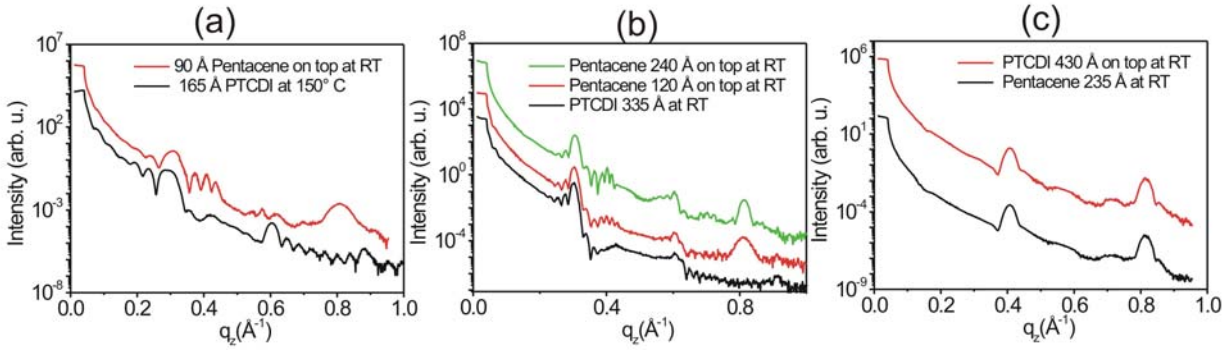

Fig. 2. Specular X ray diffraction for heterostructures of PTCDI-C8 and pentacene.

The X-ray specular scans measured simultaneously confirm this: Bragg reflections emerge from the layered growth of pentacene onto PTCDI-C8, however, PTCDI-C8 onto pentacene do not show any Bragg reflexions (figure 2c).

2. PTCDI and F_{16}CuPc heterostructures

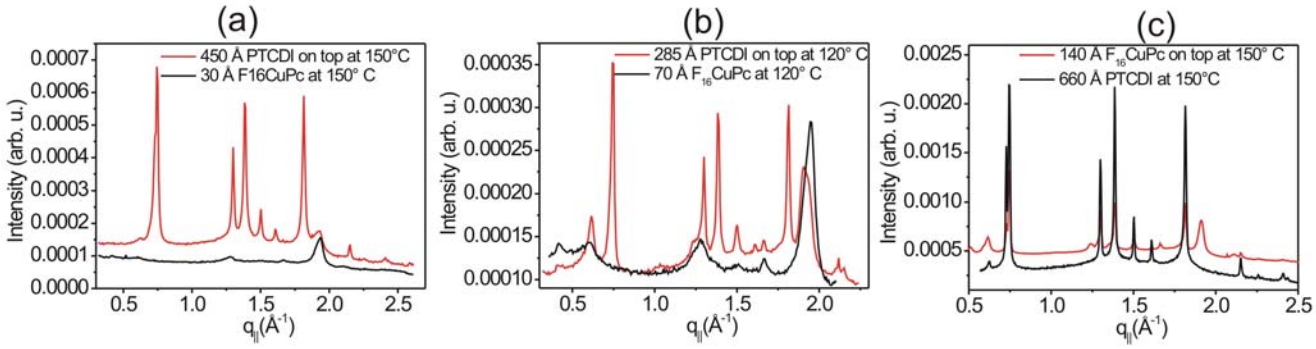

Fig. 3 GIXD data for heterostructures of PTCDI-C8 and F_{16}CuPc.

The figure 3 shows in-situ GIXD measurements for the growth of PTCDI-C8 and F_{16}CuPc heterostructures. Figure 4 depicts the specular X-ray diffraction data simultaneously obtained. Using F_{16}CuPc as template, the adlayer PTCDI-C8 shows a well ordered structure (in-plane and out-of-plane). By changing the deposition order, ordered bilayers are also obtained.

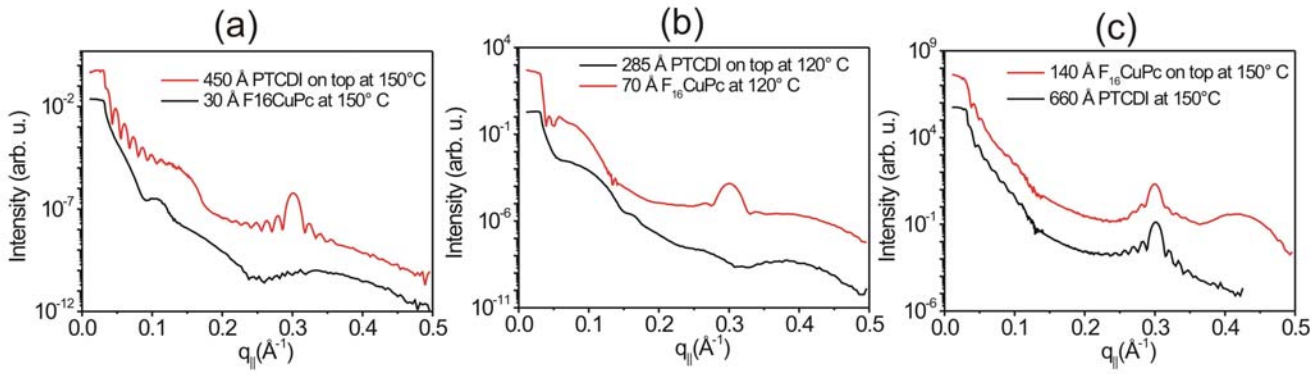

Fig. 4 Specular X ray diffraction for PTCDI-C8 and F_{16}CuPc heterostructures.

A detailed analysis of the structure and fit of the X-ray reflectivity is in progress. An analyisis of the integrated intensity of the GIXD spectra will provide further information on ordering/disordering processes at the organic interface.

In addition, real-time measurement of the intensity at 1/2 Bragg point during the growth of PTCDI-C8 on SiO_2 has evidenced an almost perfect layer-by-layer growth during more than 20 layers. The analysis of the data is in progress.

To conclude, this in-situ study (by GIXD, X-ray reflectivy) has revealed new aspects of the growth and structure of organic heterostructures. We are performing AFM mesurements as a complamatery method to understand the ordering changing of bilayers.