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# 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:** Extraordinary Molecular Alignment and Disorder Correlations in Epitaxial Organic Semiconductor Films | **Experiment number**: SC-697 |
|---|---|---|
| **Beamline**: ID10B | **Date of experiment**: from: 14.6.2000 to: 20.6.2000 | **Date of report**: 4.3.2002 |
| **Shifts:** 18 | **Local contact(s)**: B. Struth, O. Konovalov | *Received at ESRF:* |

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

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## Report:

The aim of the proposed experiment was to study the mechanisms and conditions leading to well-ordered semiconducting thin films of large organic thin films. A series of samples of Diindenoperylene (DIP) grown on silicon-oxide with different thicknesses was studied. We determined the evolution of surface roughness as a function of film thickness (in reflectivity experiments) and carried out diffuse-scattering measurements in the small-angle regime. These data were used to determine the scaling exponents in the evolution of the surface morphology which is closely related to distinct growth models. The theory of self-affine surface morphologies is a field that was extensively studied in recent years. However, there is a lack of data on large organic molecules which may exhibit different growth mechanisms compared to inorganic systems due to their shape anisotropy and weaker inter-molecular interactions. DIP thin films show a high degree of order and a lattice spacing of 16.5Å and we could measure the specular rod of each sample up to the $8^{th}$ order of the out-of plane Bragg reflection.

We have analyzed the data in combination with complementary data in Stuttgart (Non-contact AFM). The most important findings are listed below, but we emphasize that they are preliminary in nature:

1. We fitted the complete specular rod of the samples with a model based on kinematical scattering theory and were able to determine the electron density along the z-axis, $\rho_{el}(z)$, to a high degree of

precision. It turned out that the electron density exhibits strong oscillations with a ratio between maximum and minimum of approximately 2.

2. We could determine the evolution of the roughness as a function of film thickness and could determine the growth exponent $\beta$ which plays an important role in the theory of self-affine surfaces. Apparently, $\beta$, is systematically higher than what is expected on the basis of existing theories. We are in the process of improving the understanding of the underlying models together with our collaborators from the theoretical side.

3. We are currently working on the fitting of the rocking scans with a model based on the formalism of Sinha et al. [1] (see Figure). We obtain very good agreement for the fits of the diffuse scattering. These fits provide us with the roughness exponent $\alpha$ and the correlation length $\xi$ of the DIP-surfaces. We then will compare this value of $\alpha$ with the value obtained by non-contact AFM measurements.

References:

[1] S.K. Sinha, E.B. Sirota, S. Garoff, and H.E. Stanley, *Phys. Rev. B* **38**, 2297 (1988)