

## 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.



	<b>Experiment title:</b> <b>Induced substrate ordering of C60 on Pt(110) by GIXRD (II)</b>	<b>Experiment number:</b> SI-1866
<b>Beamline:</b>	<b>Date of experiment:</b> from: 17 June 2009 to: 23 June 2009	<b>Date of report:</b> 28/08/2009
<b>Shifts:</b>	<b>Local contact(s):</b> Olivier Balmes	<i>Received at ESRF:</i>
<b>Names and affiliations of applicants (* indicates experimentalists):</b> Dr. Xavier Torrelles , ICMAB, CSIC, (Barcelona) Spain Dr. Veronique Langlais, UAB, (Barcelona) Spain Dr. Maurizio De santis, Inst. Louis Neel, CNRS, (Grenoble) France Dr. Yves Gauthier, Inst. Louis Neel, CNRS, (Grenoble) France Dr. Hélio c n Tolentino, Inst. Louis Neel, CNRS, (Grenoble) France Dr Maddalena Pedio, TASC, INFN (Trieste) Italy Dr. Roberto Felici, ESRF (Grenoble) France		

### Report:

The trend of fullerene molecules to form nanoscopic pits is already well documented on the bibliography and it has been demonstrated basically by using surface X-ray diffraction techniques.

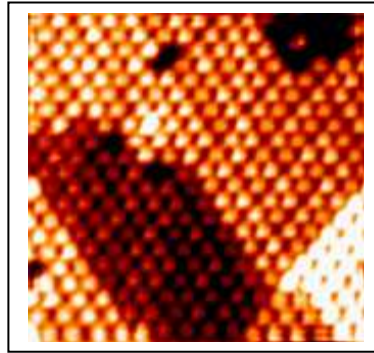
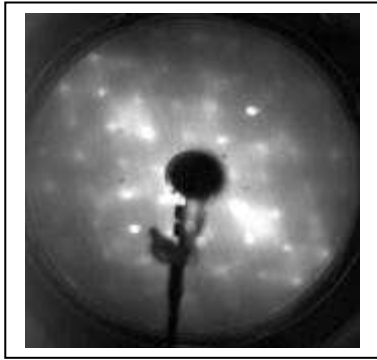
The Pt system offers strong possibilities as "inert" template for magnetic purposes. However, a previous structural characterization of the surface is necessary to understand the nature of the C60-surface substrate interaction. This study constitute a compulsory step to forthcoming experiments regarding C60 doped with magnetic atoms. The intercalation of these types of atoms in "C60-cages" would permit to design 2-Dimensional pure magnetic surface superstructures without bulk contribution.

A detailed study by LEED and STM of C60 molecules adsorbed on the clean Pt(110)-(1x2) surface allowed to

test and optimize the elaboration conditions (amount, deposition rate and surface temperature) of fullerene films.

Both techniques show 2D lateral order sufficiently good to ensure correct X-rays measurements. The surface characterization procedure starts after deposition of C60 molecules (3 ML) on the clean Pt(110)-(1x2) surface @ 450° C : the molecules are adsorbed as isolated monomers in the troughs between two Pt ridges.

After 15 minutes annealing at 850 K, and returning to RT a close-packed fullerene c(4x4) ordered surface is formed. Fig. 1 and 2 show a LEED and STM images of the final surface. Preliminary X-ray experiments performed on the same system on the BM32 ESRF beamline during permitted to confirm that the domains were large enough to perform structural x-ray analysis on the proposed system.



Figs.1,2. 1) LEED image showing the  $c(4 \times 4)$  pattern due to the C60 ordering on Pt(110). 2-3) STM image on the same system showing the hexagonal C60 surface ordering. The C60 domains are larger than 300 Å.

During the experiment we measured an extensive data set corresponding to the C60/Pt(110)- $c(4 \times 4)$  surface reconstruction. The detected experimental symmetry is compatible with the existence of two mirror planes at the surface. However, the tested models agree with a structure containing a single mirror plane and two domains to reproduce the experimental symmetry.

The measured data set includes more than 30 fractional order rods plus CTR's and some equivalent rods to check possible geometrical misalignments.

The preliminary analysis of the data shows a surface superstructure with a homogeneous distribution of Pt vacancies onto the surface where the (1x2) missing row present on the clean Pt(110) surface is partially deconstructed. The results obtained from the experiment disagree with recent DFT calculations on the basis of DFT images obtained for the same system [1]. The results will be published and presented in due course [2,3].

By the other side, we also explored the behaviour of Pt<sub>10</sub>Co<sub>90</sub>(110) single crystals after C60 deposition on the surface in similar conditions to those used for preparing the C60/Pt(110)- $c(4 \times 4)$  surface structure.

After several surface preparation procedures (sputtering/annealing/C60 deposition) no ordered superstructure reflections were detected by means of GIXRD.

Comparing these results with those of the C60/Pt(110)- $c(4 \times 4)$  ordered surface we conclude that the absence of order is mainly due to the different environment of each C60 molecule on the Pt<sub>10</sub>Co<sub>90</sub>(110) surface. Since this alloy is chemically disordered, the Co/Pt ratio shows an average stoichiometry on the surface that, locally, can be slightly different. This stoichiometric perturbation breaks the symmetry translation between neighbour C60-molecules, i.e. the C60 molecules that would be located in equivalent sites on the surface show different orientations.

## References

- [1] M. Casarin et al., J. Phys. Chem. C 111 (2007), 9365
- [2] V. Langlais et al., IV Meeting of AUSE, Barcelona (15-18 September 2009)
- [3] X. Torrelles, V. Langlais, M. de Santis, H. Tolentino, Y. Gauthier, in preparation (2009).