EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

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:** SAXS studies of breast tissue samples carrying malignant tumors	**Experiment number**: LS-1695
Beamline:	**Date of experiment**: from: 04.10.2000 to: 07.10.2000	**Date of report**: 27.2.2001
Shifts:	**Local contact(s)**: V. Urban	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

* P. Suortti, Department of Physics, University of Helsinki

* M-L. Karjalainen-Lindsberg, Department of Oncology, Helsinki University Central Hospital (HUCH)

* W. Thomlinson, ESRF

Report:

About 10 samples of excised breast tissue was studied by SAXS. A small (0.2 x 0.2 mm^2) beam of 0.1 nm wavelength was used to probe the samples in small intervals. The SAXS pattern was recorded at each position using a fast-readout CCD camera. Typical data acquisition time per frame was 50 ms. The data were corrected for read-out noise, and by the attenuation factor. Sample thickness was about 1 mm, so that in some cases the beam traversed different tissue types.

Histological examination of the samples was done after the experiments at HUCH. Different tissue types were identified, globular and ductal carcinomas, fibroadenoma, collagen-rich connective tissue, and adipose tissue (fat). The changes of the SAXS pattern were related to these tissue types by matching the histology map of the sample to the scanning grid.

In collagen-rich regions the axial periodicity, diameter and orientation of the fibrils, and their hexagonal packing distance were determined. The exponent of the intensity decrease in the power law regime was determined, and it was found to be 1 to 1.5, corresponding to the rod-like shape of the fibrils. When an in-situ carcinoma was traversed, the collagen signal became weak or disappeared, and the average intensity increased by factor of 5 or more. The power-law exponent was about 2.5, which is typical for coil-like structures.

The intensity scattered by normal adipose tissue is very low, indicating homogeneous structure with small density variations. However, in areas where cancer cells have invaded the adipose tissue the scattered intensity increases strongly, and a weak collagen signal is observed.

The results demonstrate that the SAXS patterns are characteristic to tissue types. This opens avenues for studies in two directions: the use of the SAXS signatures of the tissues for imaging, and analysis of the structures of different tissues on the molecular and supra-molecular level. The first avenue may lead to improved methods for detecting malignant tumors at early stages, and the second avenue may lead to better understanding of the biochemical mechanisms involved in cancer growth and invasion of normal tissue.