ESRF	Cancer Tissue	**number:** MD 39
Beamline: ID17	**Date of experiment:** from: 3.11.2003 to: 6.11.2003	**Date of report:** August 24, 2004
Shifts: 9	**Local contact(s):** A. Bravin	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
* P. Suortti, Dept. of Physical Sciences, University of Helsinki.
* M. Fernández, Dept. of Phys. Sciences, Univ. of Helsinki and ID17 , ESRF.
* S. Fiedler, ID17 Medical Beamline, ESRF.
* A. Bravin, ID17 Medical Beamline, ESRF.
* J. Keyriläinen, Dept. of Physical Sciences, University of Helsinki.
* H. Suhonen, Dept. of Physical Sciences, University of Helsinki.

Report:

Diffraction Enhanced Imaging (DEI) was used to image several human breast samples (see exp. report MD33). The samples were formalin fixed and the same samples were later studied by SAXS and USAXS at ID02. They were kept between kapton foils and sealed in sample holders that could be imaged together with the sample and used as reference frame for the scattering experiment. Histological slices of the samples were studied after both experiments, and the results compared. Different tissues can be recognized from the DEI images. These images can therefore be used to guide the scattering experiments (cf. MD33).

DEI set-up consists of two perfect crystals: monochromator and analyzer. The sample is situated between the two crystals. This set-up is very sensitive to small changes of direction of the beam through the sample due to refraction effects, which are converted into intensity changes by the analyzer crystal. The images were acquired with a FReLoN CCD detector, situated after the analyzer crystal. The samples were scanned through the flat beam, and images were formed line by line.

Several images were taken from each sample, at three positions of the rocking curve: top, minus and plus. These images were used to reconstruct the apparent absorption and refraction images (see Figure 1). The DEI images, apparent absorption and refraction, are the result of applying the DEI algorithm pixel by pixel to the three

original images. The DEI algorithm separates the refraction and apparent absorption from the rest of the signals, using the slopes of the rocking curve. The boundaries of the tissues are clearly visible from the refraction images, due to sharp changes on the refraction index at the interfaces. These boundaries would not be visible by absorption radiography. This is pointed out in the apparent absorption image (see Figure 1) were no details about tissue structure can be seen. In comparison, the refraction image presents many details related to the tissue structure.

Moreover, extra studies of the widening of the DEI rocking curve were performed. At certain interesting sample positions, some analyzer scans were done. The sample was kept static, and the detector was read in pipe-line mode while the analyzer was scanned through. The scanning range went up to several times the width of the crystals' rocking curve. These results are correlated with the USAXS results of experiment MD33 at ID02.

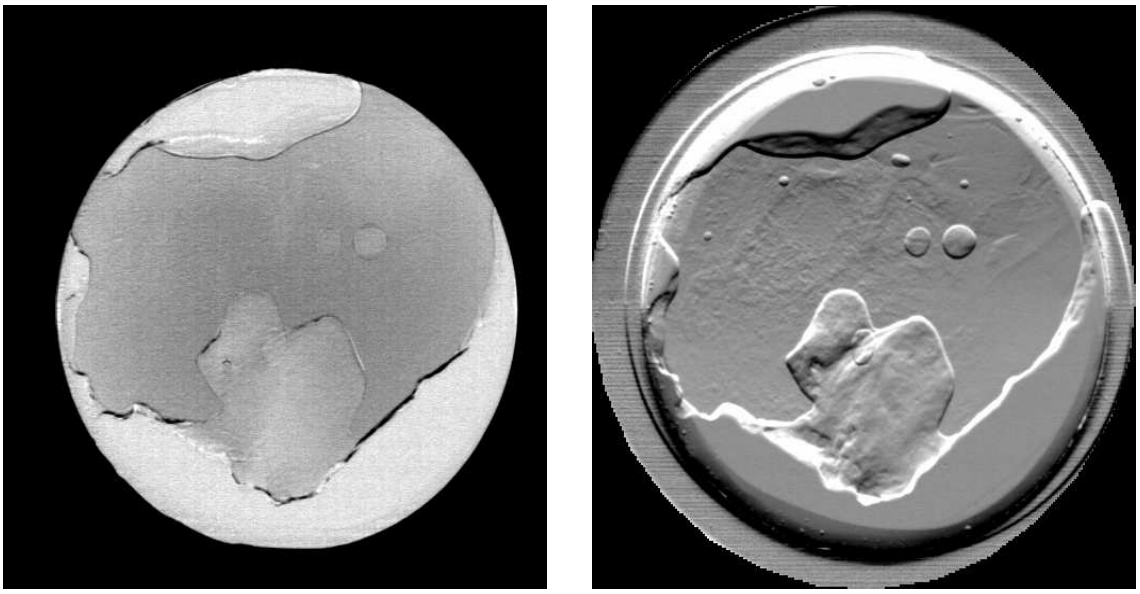

Figure 1: DEI images from a breast sample. Left: apparent absorption image. Right: Refraction image. (Note the artifacts due to refraction at air bubbles.)