EUROPEAN SYNCHROTRON RADIATION FACILITY
INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

	Experiment title: **SMALL ANGLE SCATTERING OF BIOLOGICAL TISSUES**	**Experiment number**: Md119
Beam line:	**Date of experiment**: from:4/5/2005 to:6/5/2005	**Date of report**: 11/10/2005
Shifts:	**Local contact(s)**: Stephanie Finet	*Received at ESRF:*

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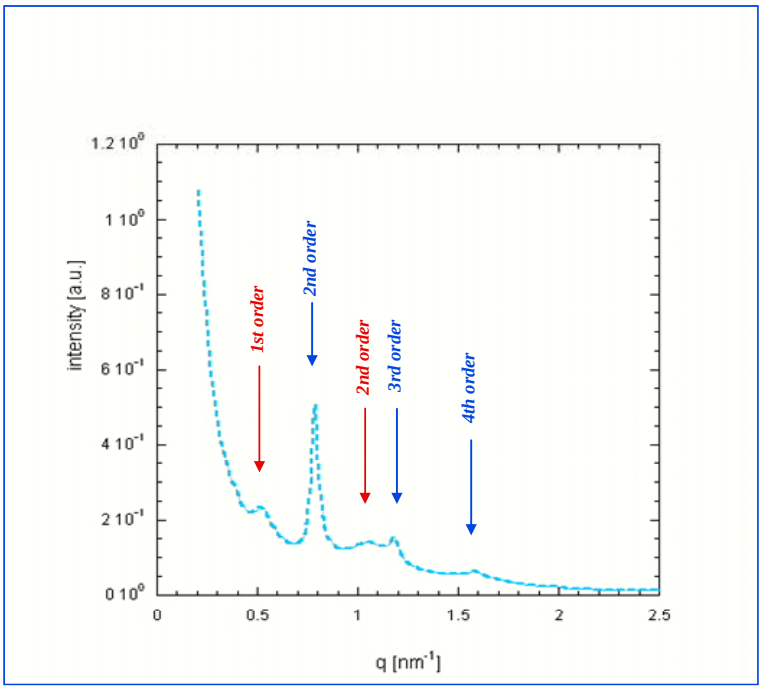
Report:

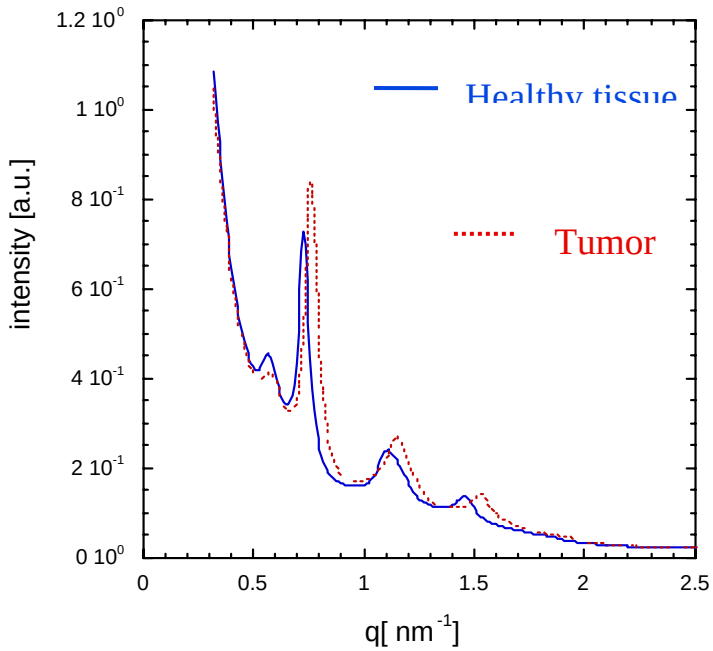
During the 6 shifts which had been allocated for the experiment we used 1 shift to align all the optical elements of the beam line and to carry out a calibration of the detector distances. In order to maximize the q-range of the cross section measurements two distances of the small angle scattering detector were used, at 1.2 m and 5m, together with the wide angle option of the beam line (WAXS). In this manner we determined the differential cross section of different samples in the q-region between 0.0006 nm^{-1} and 0.4 nm^{-1}.
The measurements have been carried out using the transmission geometry. During this beam time x-ray diffraction patterns from several biological samples have been recorded. In particular we measured samples from human tissues as bone, brain, fat, liver, skin and muscle, and for two (bone and brain) tissues of animal origin.
The sample holder was an Al bar 180mm long and 50mm wide with eight holes having a diameter of 10mm. Most of the samples were sealed with two layers of kapton. The x-ray monochromatic beam energy was fixed at 12.4 Kev.

Because biological tissues do not have high degree of homogeneity, all the samples have been measured in 30 different locations, in order to exactly determine the mean pattern, the fluctuation around the average and the characteristic features of each tissue.

As shown in the following picture in the case of the human brain tissue, two series of peaks are observable corresponding to the two values of the lattice parameter a. The blue series with a = 15.8 nm (myelin) and a red series with a=11.9nm (unknown)



We have also performed scattering measurements on both healthy and tumor rat brain tissues. A preliminary analysis of the data suggests a possible difference on the diffraction patterns between the healthy and the tumor tissues (see following picture). This could be associated with a modification of the myelin structure after comparison with histology.



Moreover, a part the tissue characterization, the other aim of the measurements was the determination of the experimental form factors for several biological tissues to implement the data bases of Monte Carlo codes used in dose evaluations.
As an example, we discuss the effect induced by coherent scattering of the bone in dose distributions from microbeams arrays.
Dose evaluations have been obtained using both the measured form factors and the calculated ones in the frame of the independent atomic model approximation (IAM).
From these computations we estimated that the diffraction from a 0.5cm thick skull bone is responsible for a peak to valley ratio degradation of about 50% in the case of a planar microbeams array at 50 keV. This deterioration in the peak to valley ratio is crucial for the planning of MRT experiments. In the following picture we show the deposited energy profiles at the center of a microbeam array made of planar, 1cm high and 10 μm wide microbeams. The beam lateral periodicity is 100 μm. The total illuminated area is 1 x 1 cm^2.