XMaS the UK-CRG	**Experiment title:** Investigation to quantify the trace elements Ca, Fe, Zn and Rb in normal and pathological breast tissue using XRF	**Experiment number:** 28-01-61
Beamline: BM 28	**Date of experiment:** from: 28th June 2000 to: 30th June 2000	**Date of report:** 10th Sept 2000
Shifts: 6 shifts single bunch	**Local contact(s):** Anne Stanault	*Received at XMaS:*

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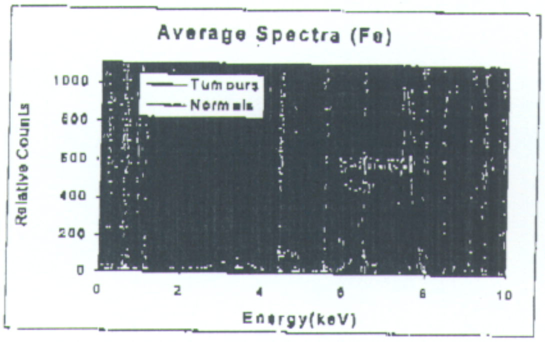
Report:

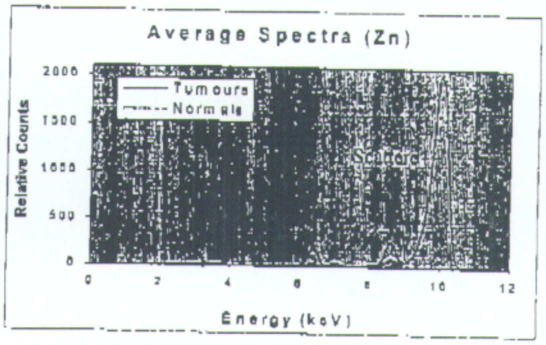
The aim of the experiment that took place at the Xmas beamline was to investigate whether the proposed set-up would be suitable for detecting trace elements in breast tissue samples. The intention was to use synchrotron radiation to detect and quantify certain trace elements through their X-ray fluorescence (XRF) radiation which is emitted when the elements present are stimulated with X-rays of the appropriate energy.

The methodology (based on previous measurements at the Radiation Laboratory of City University) was to quantify the amounts of Fe, Cu and Zn present in the tissue samples, and also to investigate the presence of Ca and Rb. On that basis, calibration standards were prepared and measured for Fe, Cu and Zn. Depending on the element of interest, the sample (or the calibration standard) was irradiated with a beam of energy 500eV above the element's absorption edge, in order to maximise the emission of the XRF response while keeping sufficient resolution between that response and the scattered incident peak. The radiation emitted from the sample was recorded via an HPGe detector and the associated electronics.

The samples were of two kinds, healthy tissue from breast reduction surgeries, and cancerous from biopsies or mastectomies. In total 21 samples of each kind were studied. Further more, there were 5 paired samples, that is cancerous and healthy tissue from the same person (these are included in the 21). The following figures show the mean healthy/tumour response spectra for two incident beam energies, 7.6 keV and 10.2 keV (for Fe and Zn). Each sample spectrum was normalised with respect to the standards (using the scattered incident peak) in order to account for the different self-attenuation within each sample. The three low-energy peaks correspond to Argon (present in air), K and Ca. Unfortunately we were not able to resolve the two peaks of interest (K and Ca), but we are confident that the problem could be overcome with the use of a Si detector.

In every spectrum the peak areas were calculated using appropriate software and the areas were related to element concentrations (in ppm) using the calibration curves. From the two figures it is apparent that the mean Fe and Zn areas -and consequently concentrations- are higher for the tumour samples compared to the healthy ones. However, the two elements cover a wide range of quantities within each group of samples, which results in large standard deviations of their means, a fact that affects the comparison between the two groups.





Alternatively, the confidence intervals for the means of the two groups do show a difference between them, as shown on the following table. Also, the calculations of t-tests for comparison between the means give p values that show highly significant difference between them. Because of time restrictions the measurement of Cu was not completed.

Fe	Mean ppm	S.D.	99%Conf.Int.	p value	**Zn**	Mean ppm	S.D.	99%Conf.Int.	p value
Normal	3.57	3.88	(1.39 , 5.75)	0.002	Normal	2.41	2.47	(1.02 , 3.8)	0.0001
Tumour	10.3	8.14	(5.76 , 14.91)		Tumour	8.18	5.4	(5.14 , 11.22)	