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Synchrotron X-ray fluorescence microscopy of biological specimens: basic instrument arrangement and a trial measurement

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1 Introduction

Synchrotron-radiation based X-ray fluorescence analysis (XRF) has been established over past forty decades to detect metals in materials such as mine soils and dust particles in the fields of materials science, cosmogeochemistry and environmental science. Recently, its use for biomedicine has just come into bud[1]. However, researchers like us in medical fields are not familiar with a basic synchrotron facility because we had no chance to visit the synchrotron which appeared to be an industrial plant. It may be one of the reasons why the biomedical use of synchrotron is not widely applied to biomedicine. In this short report, we introduce basic instrumentation of the XRF beamline and present an example of measurement.

2 Experiment

We previously found that tissue trace elements, such as iron (Fe), copper (Cu), zinc (Zn) were preserved relatively well during sample preparation processes for formalin-fixed paraffin-embedded (FFPE) pathological specimens[2]. Basic arrangement of main instruments such as polycapillary X-ray beam, SSD detector and sample holder were shown in Figure 1.

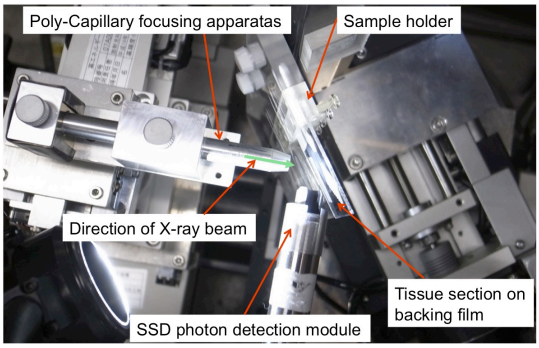

Figure 1 Instrument arrangement. Direction of X-ray beam was shown by light green. Backing film attached tissue section was set in the sample holder during measurement. The same area of sample with same backing film was irradiated by X-ray beam with 10 keV. The resultant fluorescence X-ray was detected by SSD detector (Roentec, Germany) and resultant fluorescence X-ray emission was analyzed with energy dispersive spectrometry (XEDS) shown by the histogram. The poly-capillary X-ray beam was focused to spot size of 20-30 micrometers.

3 Results and Discussion

Histograms of XEDS was shown in Figure 2. Although the peak of elastic scattering (Thomson scattering, asterisk) was high, there were several clear peaks corresponding to Fe, Cu and Zn indicated by blue, purple, and red arrows, respectively. Therefore, iron, copper and zinc are detectable in biological tissue sections. It is noteworthy that the Zn peak was slightly overlapped with the Thomson scattering peak.

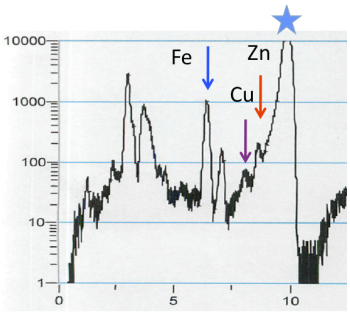

Figure 2 XEDS histogram of tissue sections.

4 References

[1] Paunesku T et al. *J Cell Biochem* 99, 1489-1502 (2006).
[2] Matsuura A et al. *Wilson disease soc bullent.* 17, 2 (2013).

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