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Detector Setting of X-ray Fluorescence Analysis for Histological Specimens

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1 Introduction

The measurement condition of X-ray fluorescence analysis is very important to analyze biological specimens. Because there are very little amount of elements on thin tissue sections, the condition setting is much more difficult than the measurement of elemental standards, such as metal foil and geological stone samples[1]. Therefore, various conditions need to be improved to increase signals/noise ratio and to maximize secondary X-ray energy resolution. We previously tested and determined the conditions of X-ray energy and thickness of backing films [2][3]. In this experiment, we determine the distance of photon detector from sample to acquire high signals and to reduce counting loss (%dead time) during defined measurement time.

2 Methods and Experiments

The silicon drift X-ray detector (SDD, Vortex-EX, Hitachi, Japan), a type of energy dispersive X-ray detector (XEDS), connected to the current amplifier (Model 428, Keithley, U.S.A.) was placed on the mobile rack that could be readily moved to adjust the distance between a tip of probe and sample (Figure 1). The thermoelectrically cooled SDD does not require liquid nitrogen. Formalin fixed paraffin embedded (FFPE) tissue sections were prepared and placed on backing films. The samples were irradiated by a 11 keV X-ray beam focused by the poly-capillary system. The resultant fluorescence X-ray emission was detected, amplified, analyzed and depicted as histogram. Basic settings of BL-4A were selected as follows: scan mode, spot analysis (MCA); acquire mode, MCA; MCA preset type, live; Preset time, 100; counter channel number, 2.

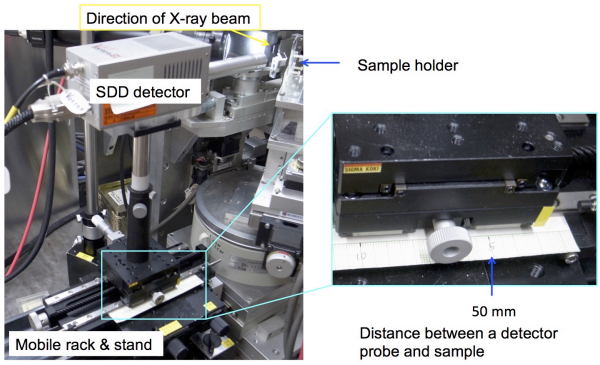

Figure 1 SDD detector and its positioning

3 Results and Discussion

The copper accumulated tissue section was used to assess relationship of copper signals and counting loss. The same area of the sample was exposed to X-ray beam (11keV) with the different distance from a tip of probe to sample. At 30 mm, the counting loss was very high; approximately 32.5%. Therefore, we tested the distance at 40, 45, and 50 mm. As shown in Figure 2, whereas the elastic scattering peak (Thomson scattering) as well as copper and other elemental peaks were gradually decreased as the distance increased, the element-specific X-ray peaks were clearly distinguishable. The resolution was sufficiently high in all settings.

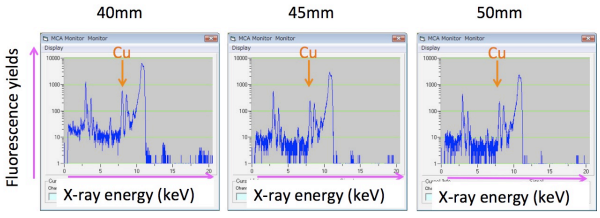

Figure 2 Fluorescence yields and probe distance

Furthermore, the counting loss of each point was gradually decreased as shown in Table 1, about 20% dead time at 40 mm, 15% dead time at 45 mm, and

about 10% dead time at 50 mm. Although the counting loss can be corrected by calculation, it is preferable to use the raw count to on-site settings.

Probe distance (mm)	40	45	50
Io incident beam(/sec)	2342	2343	2343
Copper signal (/sec)	490	250	216
% dead time	19.1	15.3	11.7

Table 1 Probe distance, incident beam intensity, copper signals and counting loss (% dead time)

We used the probe distance of 50 mm in a series of experiments using poly-capillary focusing [4]. Whether the setup is appropriate for samples contains much less amount of copper and other elements, need to be reappraised.

4 References

[1] T Paunesku et al. *J Cell Biochem* 99, 1489-1502 (2006).

[3] A Matsuura A and M Kinebuchi. *PFACR* 31, 309 (2014)

[3] A Matsuura A and M Kinebuchi. *PFACR* 31, 315 (2014)

[4] M Kinebuchi and A Matsuura. *Acute Med Surg* 2, in press DOI: 10.1002/ams2.100

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