BL-4A/2014G145

Elemental depth profiling using a thin wire in combination with a poly-capillary in microbeam X-ray fluorescence analysis

Atsuo Iida
[1]Photon Factory, Institute of Material Structure Science,
1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan

1 Introduction

Non-destructive three-dimensional analyses of materials by X-ray techniques are developing rapidly. Among them, the three-dimensional elemental imaging technique with the confocal system has been realized using synchrotron radiation [1] and laboratory X-rays [2]. The X-ray confocal technique has high sensitivity and the depth resolution of 10 μm to 50 μm. In order to realize a simpler and higher resolution depth analysis, a thin wire scanning technique was proposed in our previous paper [3]. In the proposed technique, an energy dispersive detector was situated perpendicular to the incident beam and a thin wire was set close to the sample surface and between the incident beam and the detector. When the sample was scanned normal to the sample surface, the intensity variation of fluorescence X-rays showed the elemental distribution along the depth. Though this method was simple, but it suffered from weak signal intensities. In this report, a new method which combines the poly-capillary confocal system and the thin wire technique is developed to enhance the sensitivity and to achieve the high depth resolution.

2 Experiment

Figure 1 shows a schematic representation of the experimental arrangement of the elemental depth analysis using a thin wire in combination with a poly-capillary. In addition to the confocal poly-capillary system, the thin wire was set close to the sample surface. In order to achieve the high depth resolution, a slit in front of the detector was necessary to reduce the horizontal angular divergence. The poly-capillary acts as the one dimensional (vertical) beam condenser lens and, thus, enhances the sensitivity of the wire scanning method.

Samples used to demonstrate the new method were layered metal film. For incident focusing X-rays, poly-capillary and Kirkpatrick-Baez focusing system, having a beam size of 30 μm in diameter and 5 μm square, respectively, were used.

3 Results and Discussion

Fig.2 shows Co and Cu Kα fluorescence intensities from the sample, composed of Kapton / Cu (6μm) / Kapton / Co (6μm) / Kapton layers glued together, as a function of the sample displacement (x) along the sample surface normal. Incident beams were focused with the poly-capillary. A Co film was placed near the front surface. Black and green lines correspond to the depth profile by the conventional confocal system, red and pink lines corresponds to that by the present method (adding the thin wire) and blue and light blue lines are the difference between two methods. The depth resolution was improved down to 22 μm by the present method compared to that of about 50 μm with the conventional confocal technique. The intensity gain was about three times higher than the previous method without the poly-capillary.

References

[1] K. Janssens et al., Spectrochim. Acta Part B 59 (2004) 1637.
[2] K. Tsuji et al., Spectrochim. Acta Part B 62 (2007) 549.
[3] A.Iida, X-ray Spectrom.40 (2011) 376

* atsuo.iida@kek.jp

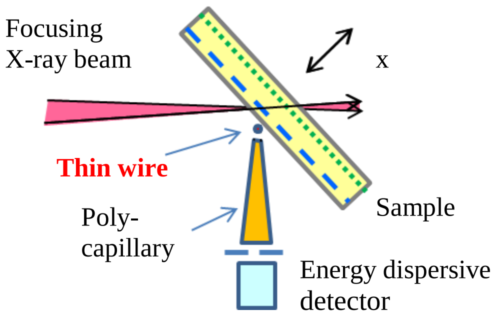

Fig.1 Principle of the depth analysis using a thin wire in combination with a poly-capillary.

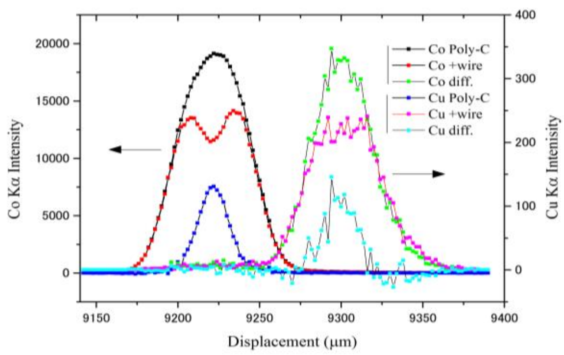

Fig.2 Co and Cu Ka fluorescence intensities as a function of sample translation (x) along the surface normal of the sample.