Development of In-lab energy filtered X-ray photoelectron emission microscope using air-core coil type multipole Wien filter

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Achieving a spatial distribution of chemical states is able to obtain valuable information for understanding a catalytic reaction mechanism. An energy filtered X-ray photoemission electron microscope (EXPEEM) is one of the most suitable techniques to realize the chemical mapping of the surface. Although EXPEEM images have been successfully obtained using synchrotron radiation source, it is desirable to develop the EXPEEM method on a laboratory scale to prevail this method for nanometer analysis of the surface chemical processes. For this purpose, we have developed a highly brilliant X-ray source and a new brighter Wien filter type energy analyzer which can accept the photoelectron in a large angle. In this presentation, we report the possibility of in-lab EXPEEM and the design of an air-core coil type multipole Wien filter.

The highly brilliant X-ray source consists of the rotating anode and the curved multilayer monochromator. The X-ray beam was focused on the sample with the size of $140 \times 290\ \mu m^2$. Consequently we obtained the intensity of 10^{11} photons/ mm^2/sec. This intensity is corresponding to the light intensity emitted from the second generation synchrotron facility.

We employed a Wien filter as the energy analyzer because it has a linear optical axis which is convenient for adjusting the optical axis. In order to decrease the aberration in the Wien filter, we designed a multipole Wien filter[1] which can correct up to the third-order opening aberration[2]. Moreover, to increase the acceptance angle, we enlarge the inner size of the filter by replacing a iron-core coil with an air-core coil. We design elongated magnetic pole and tapered electrodes in order to fit the dipole component of the electric and magnetic fields to satisfy Wien condition.

[1] H. Rose, Optik 77, 26 (1987)
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