We developed the technique of X-ray reflectivity measurement at BL19B2. The technique is useful to structural analysis of thin film because X-ray reflectivity is sensitive to its thickness, roughness of surface and electron density profile. We measured X-ray reflectivity from a surface of polycrystalline thin film on Si substrate with the thickness of about 140 nm. We used a multi-axis diffractometer installed in BL19B2 for the measurement. The energy of the incident X-ray was 10KeV. Its flux was monitored by an ion chamber. The reflected X-ray by the surface of the sample was detected by a NaI scintillation counter. The sample was mounted in a chamber filled with He gas with windows of Kapton® films for reducing the background noise from air scattering. The size of the sample is 70mm × 20mm. The incident beam was formed in a shape of 10mm × 0.1mm by a slit so that the footprint on the surface of the sample was within the size of the sample. In order to extend the dynamic range of the detectable signal, we used attenuators of Al which attenuate the flux of the incident beam. The measurement was carried out changing the attenuation rate from $10^4$ to 1 by 5 step (10$^4$, 10$^3$, 10$^2$, 10$^1$, 10$^0$) automatically.

The figure shows the data of the reflectivity as a function of the reflecting angle 2θ. We could get data with a dynamic range of 10$^7$. As shown in the inset indicating the data for 2θ =0.2~2 degree, the oscillation due to the interference of the reflected X-ray in the film is clearly indicated in the data. We will tune the attenuator to extend the dynamic range of the data up to 10$^8$.

We have measured EXAFS spectra of the four kinds of oxide, such as hafnium oxide, tantalum oxide, zirconium oxide, and cobalt oxide on BL19B2 in transmission method. These oxides are the most promising candidates for capacitor materials and gate insulator materials of sub-micron semiconductor devices because of its high dielectric constant and leak current property. These properties closely relate to the local structures such as the defects of oxygen introduced during various processes. XAFS is effective technique for characterizing local structure of amorphous as well as polycrystalline films. Figures are the Fourier transforms of EXAFS spectra for each oxide with various oxidation state.