Development of High- and Low-Energy Scanning Transmission X-ray Microscope (STXM) for Bacterial Samples

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Scanning Transmission X-ray Microscope (STXM) enables XRF/XAFS imaging with high resolution down to several tens of nanometers using Fresnel Zone Plate (FZP). The functional group mapping can be obtained by tuning the photon energy at correspondening absorption structures. The sample chamber should be used under He-purged environment to permit the study of hydrated samples under near-natural condition with additional possibilities of sample tilting, heating, and cooling. STXM has a wide range of applications including material sciences, earth and environmental sciences, and biological and bio-medical sciences.

Aim of our study here is to obtain rare earth element (REE) distribution image on the bacterial cell surface by STXM. Previous study reported that phosphate group is main binding site of REE when REE is adsorbed on the bacterial cell wall [1]. However, REE distribution image on the cell wall has not been obtained yet, while development of STXM in Japan has been delayed. For example, STXM that is able to use K-edge absorption energy of phosphorus (2.1 keV) is not available in Japan.

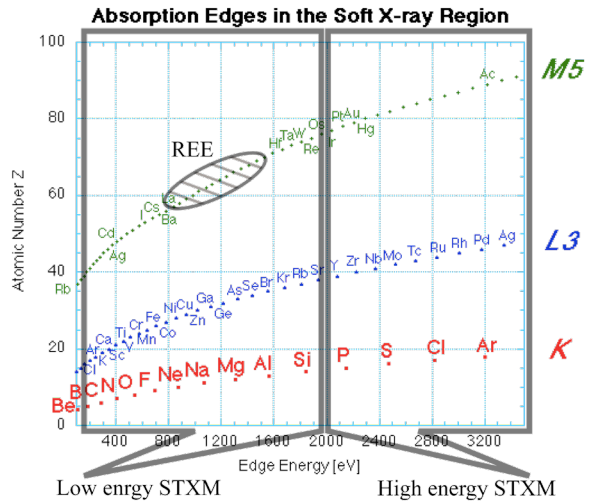

Fig. 1. Absorption edge of elements in soft X-ray region. High and low energy STXM measurement range is drawn. (http://pfwww.kek.jp/sxspec/sx/sxme.html)

Therefore, to obtain REE and phosphorous distribution image, High (0.05-2 keV) and Low (2-5 keV) energy versions of STXM (PF-STXMs) are being developed in Photon Factory (PF) at High Energy Accelerator Research Organization (KEK) in Japan. By combining the two types, it will be possible for us to measure K-edges of P (2.1 keV) and M-edge of REE (0.8-1.5 keV) for such bacterial samples. In this workshop, we will introduce the current status of PF-STXMs and their application to bacterial samples.

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[1] Y. Takahashi *et al*., Geochimica et Cosmochimica Acta. **74**, 5443 (2010).