

Probing Biological & Environmental Interfaces Under *in-situ* Conditions Using Synchrotron-based X-ray Techniques

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Synchrotron-based x-ray analytical tools are often well suited for the study of nanometer-scale chemical heterogeneities of biological and environmental specimens under *in-situ* conditions. In this presentation, we will introduce two important synchrotron-based x-ray techniques (i.e., soft x-ray spectromicroscopy and x-ray reflectivity/ x-ray standing wave) for biological and environmental studies and present our recent research activities based on these approaches.

Soft x-ray spectromicroscopy (e.g., scanning transmission x-ray microscopy, STXM) is one of the few techniques that can provide element- and chemical state- specific 2-D maps at a spatial resolution better than 30 nm. Recently, we have applied this novel technique to investigate chemical heterogeneities formed at or near a single bacterial cell. Spectromicroscopic measurements at the iron L₃- and carbon K- edges with high spatial resolution provided direct evidence for the location of biochemical reactions occurring at the cell membranes or cytoplasm of microorganisms. On the other hands, long-period x-ray standing wave – fluorescence yield (XSW-FY) technique combined with x-ray reflectivity (XR) measurement is also a well suited technique for the study of biological systems such as biomimetic membranes. XSW-FY/XR can provide highly resolved z-directional distributions (~ few nanometers) of multiple trace elements (~100 ppb) present within thin biomimetic membrane (10 nm ~ 1 μm). These XSW-FY measurements combined with STXM imaging tool is a promising tool to probe various reactions occurring at the biological and environmental interfaces.