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Cryo Soft X-ray Tomography Beamline at Taiwan Photon Source

Visualize the subcellar structures within cells is important to understand biological phenomena in details for biomedical research. Microscopy plays and important role to fulfill this demand. Among all the microscopy techniques, transmission electron microscopy (TEM) and fluorescence microscopy are two major imaging modalities to explore the cellular structures. Fluorescence microscopy can image in-vivo cell samples with nanometer resolution but only fluorescent-labelled structures can be observed. TEM allows to image the fine structures of organelles with high contrast and extraordinary resolution of few nanometers. However, thickness of sample is limited because of low penetration depth of electron and sample preparation for TEM is relatively time-consuming.

Soft X-ray tomography (SXT) is a relatively new imaging tool in imaging entire cells. The imaging of SXT uses X-ray source with energy between 284eV and 543eV, which are the K absorption edges between carbon and oxygen. In this so called “water window” region, water is nearly transparent but carbon and nitrogen, the major constituents of biomolecules, are absorbing. Imaging in this range thus allows to obtain the high contrast carbon-based images of hydrated, intact cells in few micrometers thickness without the needs of time-consuming sample preparation procedures, such as labelling, embedding and sectioning. Due to this uniqueness, SXT can be an excellent complementary imaging technique for fluorescence microscopy and TEM. SXT beamline at Taiwan Photon Source (TPS) in National Synchrotron Radiation Research (NSRRC) is designed with achievable resolution of 15–30 nm for 2D imaging and 50 nm for 3D imaging. SXT beamline is now partially open to public. Here, we report the current commissioning progress of SXT beamline. We also demonstrate the preliminary results of imaging cryo-fixed biological samples by using SXT.

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