Development of soft X-ray tomography beamline in biomedical researches

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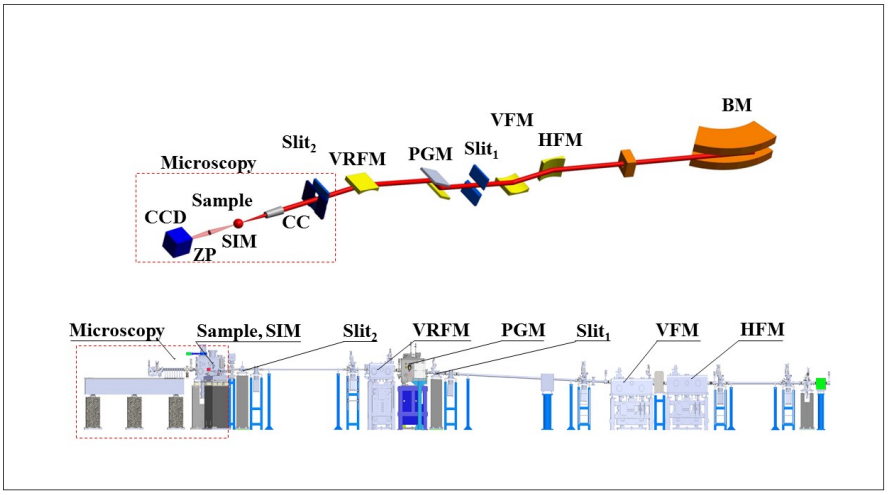
Soft X-ray Tomography (SXT) Beamline is the first beamline of the second phase construction in Taiwan Photon Source (TPS). This beamline is a full-field transmission microscopy, which is dedicated to image 3D frozen-hydrated whole cells and tissue. Based on the organic composition of biological specimen, the energy of soft X-ray between K-edge absorption of carbon (284 eV) and oxygen (543 eV), called water window, can bring a high different absorption coefficient from the water environment and produce a natural contrast of a bio-image. The penetration depth in biological sample is about 10 μm in energy of water window, indicating it is possible to obtain a 3D image from nearly native thick cells without the need of staining and sectioning.[1,2]

SXT beamline covering the energy range of 0.26 $\sim$ 2.6 keV is designed with the optics of varied-lines-spacing plane grating monochromator (VLS PGM) to provide a secondary source with fixed position for condenser in soft X-ray microscope[3]. The soft X-ray microscope adopting a design in association of a condenser and an objective Fresnel zone plate[2] is expected to obtain a spatial resolution of 15$\sim$30 nm for 2D imaging and 50 nm for 3D tomography in biological studies. Additionally, an on-line cryo-fluorescence structured illumination microscopy (SIM) is correlated with SXT to provide the sample imaging with functional and structural information. The beamline has completed the installation in the end of 2017 and now is under the commissioning.



Conceptual and mechanical designs of soft X-ray tomography beamline.

References

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[3] E. Pereiro, J. Nicolás, S. Ferrer and M. R. Howells, J. Synchrotron. Rad. **16**, 505 (2009).