



Contribution ID: 174

Type: **Talk**

Lab-based Correlative Fluorescence and Soft X-ray Microscopy

The combination of different imaging techniques offers a more comprehensive understanding of biological samples. The structural contrast of soft X-ray (SXR) microscopy, for example, can be excellently combined with the functional contrast of fluorescence microscopy (FLM). We present a laboratory-scale microscope that combines SXR microscopy and wide-field FLM in a single setup.

Our system utilizes a laser-produced plasma source, a so called Gas-Puff-Tarjet, as a compact source for SXR radiation in the water window spectral range (2.3–4.4 nm). The water window is ideal for imaging of biological samples. Due to the high absorption of carbon, a strong structural contrast is achieved with a high penetration depth in water ($\approx 10 \mu\text{m}$). Our wide-field zone plate microscope achieves a spatial resolution of 50 nm half pitch, measured with a Siemens star. The integrated FLM allows for the localization of labeled components, providing functional context to the high-resolution structural data from the SXR microscope.

The design enables seamless switching between modalities without moving the sample, ensuring unaltered correlation of the acquired images. We demonstrate correlative imaging of various biological samples, including bacteria, and labeled mammalian cell lines (COS-7, NIH-3T3).

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Session Classification: Parallel: Matter (RT1)

Track Classification: RT1