Table-top soft x-ray microscopy with a laser-induced plasma source

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Introduction and Objectives

The spectral range of the 'water window' (λ = 2.3 to 4.4 nm) represents a highly interesting regime for studying carbon-based specimen, due to a 10 times higher absorption of carbon compared to oxygen and water. This opens up a variety of applications, e.g. high resolution microscopy and near-edge x-ray absorption fine structure (NEXAFS) spectroscopy. These studies are typically conducted at synchrotrons; however, as the interest in imaging techniques and surface sensitive chemical analytics is growing, there is also a considerable demand for compact lab-based soft x-ray sources.

Results and Discussion

Making use of the long-term stable and nearly debris-free laser-induced plasma from a pulsed nitrogen gas jet target, an extremely compact soft x-ray microscope operating in the 'water window' region at the wavelength λ = 2.88 nm was installed [1]. With this microscope structures with a size of about 50 nm can be resolved (see Fig. 1).

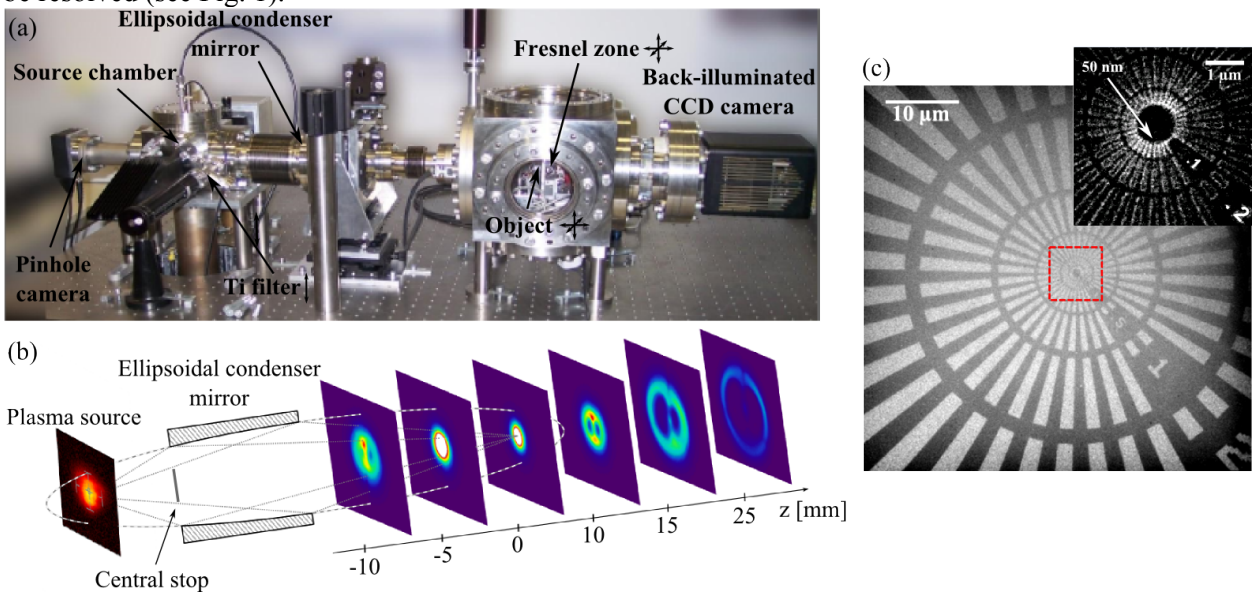

Figure 1: (a) Photograph of the table-top soft x-ray microscope. (b)Spatial intensity profiles of soft x-ray radiation at 2.88 nm for different positions along the optical axis behind the ellipsoidal condenser mirror. (c) Soft x-ray micrograph of Siemens star recorded at 2.88 nm (magnification 250x, effective pixel size 52 nm, 18 000 pulses, and exposure 60 min). The inset shows the central part of the Siemens star recorded separately at magnification 500x.

Conclusions

In this paper, an overview on the latest results using the table-top soft x-ray microscope is given including a brief description of the imaging performance of the microscope as well as a compilation of micrographs from different sample systems.

References

[1] M. Müller, T. Mey, J. Niemeyer, and K. Mann. Table-top soft x-ray microscope using laser-induced plasma from a pulsed gas jet. *Optics Express*, 22(19):23489-23495, Sep 2014.