Laser plasma source of the extreme ultraviolet and soft X-ray radiation for NEXAFS and imaging applications

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Visualizing small objects in the nanometer scale with high spatial resolution is very important from the point of view of modern science and technology. To extend the diffraction limit associated with the wavelength of radiation, one possible way is to reduce the wavelength, allowing smaller features to be resolved and visualized. Additionally, acquiring spectral information about the samples using near edge X-ray absorption fine structure (NEXAFS), which is a well-known and established method employed for a compositional analysis of the samples, yields information about its elemental composition through the observation of the spectral features in the vicinity of the high energy side of the X-ray absorption edge [1].

Those techniques allow to characterize the matter in micro- and nanoscale, obtaining useful and important information about the investigated objects [2], such as an internal structure of the cells [3] through the natural optical contrast in the "water-window" spectral range, or the structure of intermolecular and atomic bonds in the spectroscopic measurements. In particular, NEXAFS is often used to study the structure of intermolecular bonds of polymers [4] by probing the electronic transitions from the core level to the unoccupied states. The NEXAFS spectra contain information which is element specific, indicating additionally the structure of the molecular bonds [5].

This requires short wavelength sources, capable of delivering sufficient flux to achieve high signal-to-noise ratio images with nanometer spatial resolution or high quality spectral data in the time frame from *fs* to *ns*. These sources are synchrotrons, free electron lasers, but also compact sources; among them the laser-plasma source based on a double stream gas puff target. The application of this source to recently developed compact microscopy and spectroscopy systems will be the main topic of the presentation. Merging those two techniques a spectromicroscopy, obtained by a raster scanning of the sample and acquiring spatially localized spectral data for composition analysis and spectral correlation was also performed and will be presented.

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