

Table-Top System for High-Resolution Soft X-ray Absorption Spectroscopy

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X-ray absorption spectroscopy is a well-established technique for compositional sample analysis, probing electronic transitions from core levels to unoccupied states and yielding unique information about the sample, including bond type, oxidation state, coordination, and hybridization of molecular orbitals. However, this technique is almost exclusively available at large-scale research facilities such as synchrotrons, which are able to provide the necessary high photon flux. This applies in particular to the soft X-ray spectral range. With the R&D progress in recent years in the development of table-top soft X-ray sources [1], laboratory-scale spectroscopy in this wavelength range is now available and offers a viable and sound alternative to large-scale synchrotron devices.

We present recent developments of our pulsed gas target based laser-induced plasma source which covers a spectral range from EUV to soft X-rays. The use of a krypton gas jet as laser target provides debris-free broad-band radiation in the energy range between 250 and 1000 eV. Based on this source, we developed an extremely compact integrated soft X-ray absorption spectrometer system. The spectrometer is equipped with a high line-density flat-field grating, accomplishing a spectral resolution of $E/\Delta E = 1535$ at 430 eV. Simultaneous multi-edge analysis at various absorption edges is possible. The performance of this new system is demonstrated by investigating the fine-structure of K- and L-absorption edges of various elements for different types of thin samples in solid or liquid phase. An excellent agreement with synchrotron spectra is achieved [2].

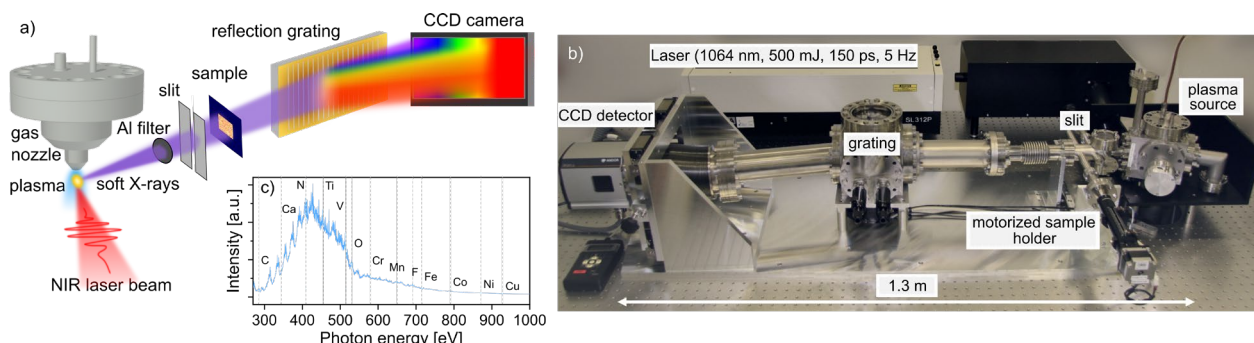


Fig. 1. Schematic drawing (a) and photograph (b) of the table-top NEXAFS spectroscopy system. In the characteristic krypton plasma emission spectrum (c) the accessible K- and L-shell absorption edges of prominent elements in the soft X-ray spectral range are indicated.

[1] J. Holburg, M. Müller, K. Mann, *Opt. Express* **29**(5), 2021, 6620-6628.

[2] J. Holburg, M. Müller, K. Mann, P. Wild, K. Eusterhues, J. Thieme, *Anal. Chem.* **94**(8), 2022, 3510-3516.