

Ultra-compact inline transmission grating spectrograph for extreme ultraviolet wavelengths

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For the measurement of the spectral distribution in a broadband wavelength range, spectrographs are typically used. Depending on the target application, the spectrograph can be designed for reflection or transmission mode. Although reflective spectrographs generally offer a higher resolution due to the possibility of applying aberration corrections and focusing options, the main advantages of a transmission grating spectrograph are its compactness and the possibility of inline positioning while still offering sub-Ångström spectral resolution if designed carefully.

In this contribution the design, realization, and characterization of an EUV transmission grating spectrograph (EUV-TGS) are presented. The main module of the realized EUV-TGS comprises a spectral and spatial filter and a high-resolution transmission grating with a period of 80 nm. All components were fabricated in-house using multi-step cleanroom processes. For high resolution spectral monitoring in the target wavelength range of 10 nm to 20 nm, a two-dimensional detector is positioned in proximity to the main module. The overall dimensions of the EUV-TGS have been minimized to 25 x 25 x 40 mm³, allowing for simplified integration into existing beamlines and experimental setups. The realized prototype demonstrates a spectral resolution of 0.08 nm, perfectly suited for the detailed investigation of EUV radiation sources (Fig. 1).

In our use case, the EUV-TGS prototype is integrated in an interference lithography setup for monitoring tasks, demonstrating that this ultra-compact spectrograph can easily be introduced into experimental setups that will benefit from an inline spectroscopic diagnostic option.

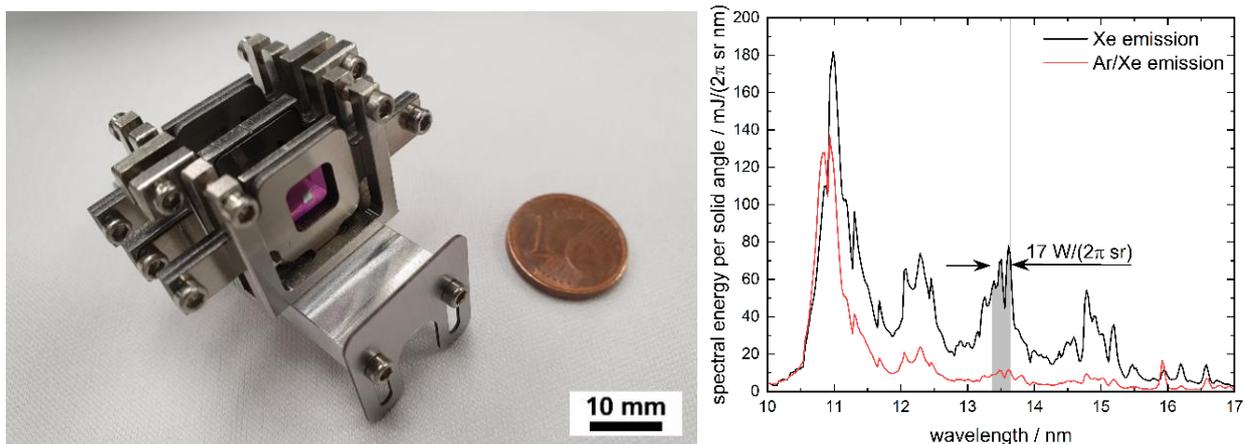


Figure 1 Realized ultra-compact transmission spectrograph consisting of a filter, aperture and transmission grating (left). Measured emission spectrum of the characterized discharge-produced plasma EUV source (right).

[1] S. Brose, S. Danylyuk, B. Lüttgenau, I. Gisch, L. Lohmann, J. Stollenwerk, C. Holly, (2023), Proc. SPIE 12750, 12750Q