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Laser-plasma soft X-ray sources based on a gas puff target for application in absorption spectroscopy and coherence tomography

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The results of recent work on the development of laser-plasma sources of soft X-ray and extreme ultraviolet (EUV) radiation for application in science and technology are presented. The radiation is generated as a result of the interaction of nanosecond laser pulses with a gas puff target. The target, which is created by injection of a small amount of gas at high-pressure using a solenoid valve with a gas nozzle, is irradiated with nanosecond laser pulses with an energy of the order of a single J per pulse at a repetition rate of 10 Hz using commercially available Nd:YAG lasers. The use of a gas puff target enables efficient generation of radiation in the spectral range from about 1 nm to about 100 nm without nozzle degradation. The sources have been used in various fields of science and technology, including: plasma physics, metrology, emission and absorption spectroscopy, materials processing, nanoimaging, radiography and tomography, radiobiology and biomedicine.

This paper presents the results of the latest research aimed at improving the source parameters by using a gas puff target containing micron-sized liquid droplets or solid particles (aerosol targets). Using a laser-plasma source with a new target approach, a mobile laboratory workstation was developed for application in X-ray absorption fine structure (XAFS) spectroscopy and coherence tomography (CT). The view of the workstation and is CAD design are presented in Fig. 1.

Fig. 1. The view of the XAFS/CT laboratory workstation and its CAD design.

The XAFS/CT workstation is available to external users as part of the European RIANA (RIANA – Research Infrastructure Access in NAnoscience & nanotechnology) and Lasers4EU (Lasers4EU) projects.

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