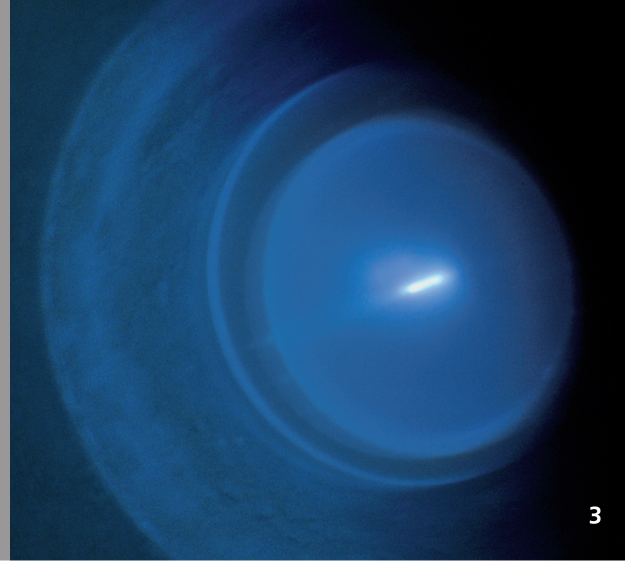

RADIATION SOURCES FOR THE NEXT GENERATION OF LITHOGRAPHY IN THE EXTREME ULTRAVIOLET [EUV]

Task

In addition to the EUV sources required in lithography for the production of the next generation of computer chips, such sources are also needed for metrology. This field requires preferably inexpensive and compact radiation sources that, nevertheless, exhibit a high power density and brilliance. Particularly in metrology and the technology development for lithography, the possible applications use a central wavelength around 6.x nm, which is considered a possible successor to the currently examined technology at an operating wavelength of 13.5 nm. To date, compact EUV sources for 6.x nm are not available.

Method

In the past, Fraunhofer ILT developed a compact, discharge-based system, which has been commercially available since 2013 and is used at 13.5 nm in applications supporting EUV lithography. In the conceptual design, a gas is so strongly compressed and heated by an electrically pulsed current of a discharge that characteristic radiation is emitted. There are few restrictions with respect to the working gas, thus resulting in a high spectral emissivity. Current studies are exploring the potential of this concept in terms of the efficient excitation of radiation at 6.x nm.

Result

By using krypton as the working gas and adjusting the discharge parameters, Fraunhofer ILT has generated photon fluxes that have made first applications possible, for example, the characterization of optics. Repetition rates reached so far are up to 1,000 Hz in steady operation. In the spectral range between 6 nm and 7 nm, values of 15 W / (2π sr) are currently reached.

Besides the use of krypton, nitrogen (intensity of the emission line at $\lambda = 2.88$ nm at 15 W / (2π sr)) and xenon (40 W / (2π sr) @ 13.5 nm +/-1 %) can also be used as working gases.

Applications

- Mask inspection for EUV lithography
- Technology development in the EUV environment, e.g. resist development, characterization of optics
- EUV-based metrology for nanosciences

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2 Radiation source for extreme ultraviolet light.

3 Photograph of the pinch plasma (VIS) of the EUV radiation source.

Subject to alterations in specifications and other technical information. 09/2014.