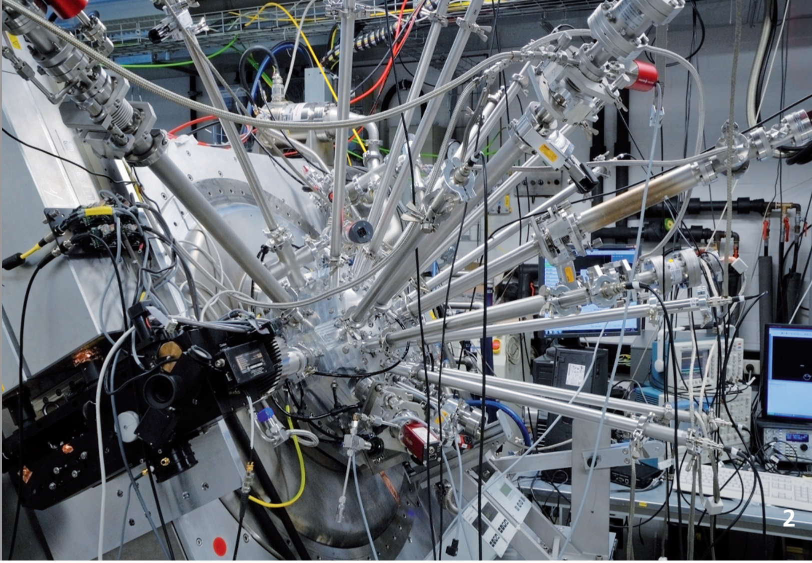

POWER SCALING OF A RADIATION SOURCE FOR EXTREME ULTRAVIOLET LITHOGRAPHY (EUVL)

Task

To produce computer chips of the future, based on EUV lithography (EUV = extreme ultraviolet), manufacturers need high-power radiation sources with a central wavelength of 13.5 nm. For several years, Fraunhofer ILT has been developing such radiation sources in close cooperation with industry partners. The technical basis for these sources is the vacuum arc in tin vapor: here, in a pulsed electrical discharge, tin plasma is excited to emit characteristic radiation at 13.5 nm. As a developmental goal for these radiation sources several kilowatts light power in a spectral bandwidth of 2 percent around the central wavelength of 13.5 nm into half- space is challenged by the industry. This technical goal can then only be achieved if the source parameters are identified which enable an efficient EUV radiation generation. From these parameters, mean electrical input power in the range of over 100 kW can be optimally converted into EUV light power.

Method

An experimental EUV source was set up to investigate the fundamental physical mechanisms and their correlations of light generation. The source allows high flexibility in the variation of its parameters as well as the possibility of installing a multitude of diagnostics for the plasma in parallel. This guarantees a comprehensive characterization of the radiation source itself and the interrelations between parameterization and EUV radiation generation. Of essential interest here are the plasma geometry, the beam characteristic in the EUV and the conversion efficiency of the electrically stored energy in EUV light. What was varied was, among others, the electrical current pulse form, given by the capacitance of the electrical circuit, the electrical pulse energy and the distribution of the tin vapor between the electrodes, which can be influenced by a pulsed trigger-laser with adjustable parameters.

2 Beam source in extreme ultraviolet on the basis of a tin vacuum spark.

Result

For the first time, a parameter space could be identified with which the vacuum arc in tin vapor can fulfill the requirements upon a prospective production source.

Applications

The technology will be chiefly used in EUV lithography either to expose wafers or in EUV metrology, e.g. in reticule inspection.

The results are outcome of the collaboration with Xtreme Technologies GmbH on laser assisted discharge plasma (LDP) sources for EUV lithography.

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