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High Power Extreme Ultra-Violet (EUV) Light Sources for Future Lithography

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Extreme Ultra-Violet (EUV) lithography is most likely to be used for the production of semi-conductors from about 2009. This technology will use 13.5 nm radiation to image features of 32 nm and below. One of the potential showstoppers in the commercialisation is the availability of a compact, high power source. Roughly, 500 to 1000 W in 2π sr and within a 2% bandwidth is required. Moreover, the lifetime of the first collector mirror (located at 10 to 20 cm away from the light source) should exceed half a year in continuous operation.

This paper gives an overview of the latest developments in plasma-based EUV sources. In this case, transition radiation of highly ionised atoms (like Li III, O VI, Xe XI and Sn VIII to XIII) is used. There are two different schemes to achieve the high plasma temperatures (20 to 40 eV), which are necessary to reach these ionization stages: laser-produced plasmas (LPPs) and discharges. The progress within the first category seems to be limited as LPPs are roughly at the same level as five years ago. In the field of gas discharges and vacuum sparks, a lot of progress has been made recently. Especially vacuum sparks seem to offer the possibility to meet the specifications for high-volume manufacturing.