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EUV-FEL light source for future lithography

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In EUV lithography, high volume manufacturing already started using a laser-produced plasma (LPP) source of 250-W power at 13.5 nm. However, development of a high-power EUV light source is still very important to overcome the stochastic effects for a higher throughput and higher numerical aperture (NA) in future. The required EUV power for the 3-nm node and beyond at the maximum throughput of future scanners is estimated to be more than 1 kW. We have designed and studied an EUV-FEL light source based on ERL for future lithography [1,2]. This light source offers many advantages such as high EUV power (> 10 kW), upgradability to a Beyond EUV (BEUV) FEL for finer patterning, polarization controllability for high-NA lithography, low electricity consumption and cost per scanner, as compared to the LPP source. Excellent high-power performance of the EUV-FEL light source was newly demonstrated by a start-to-end simulation with new optimization and more accurate calculation and conceptual schemes of upgrade to a BEUV-FEL, polarization control of the FEL light and an optical beamline to the scanners were proposed. Proof of concept (PoC) of the EUV-FEL light source using an IR-FEL constructed in the Compact ERL (cERL) at KEK is also in progress. In this presentation, we will present the EUV-FEL light source for future lithography including the PoC using the cERL IR-FEL.

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Footnotes

[1] N. Nakamura et al., Proc. of ERL2015, Stony Brook, New York, USA, pp.4-9 (2015).
[2] H. Kawata, N. Nakamura, H. Sakai, R. Kato and R. Hajima, J. Micro/Nanopattern. Mater. Metrol. 21(2), 021210 (2022).

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