

Compact, bright, plasma-based EUV lasers for metrology

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Metrology for semiconductor circuit manufacturing requires bright sources of EUV radiation. Compact plasma-based EUV lasers produce bright beams of EUV light from amplification in atomic transitions. These compact atomic lasers are characterized by a high brightness, narrow line width, and high average power. Advances in diode-pumped optical lasers are now allowing EUV lasers based on laser-created plasmas to operate at new heights in repetition rate and average power in the 10-20 nm wavelength region. At longer wavelengths, new interest in metrology at 47 nm fits well the unique capabilities of compact discharge-driven EUV lasers based on fast discharge excitation of an argon-filled capillary channel, which produce beams with tailored degree of coherence and unsurpassed average power. These lasers are now commercially available. Application of EUV lasers to nano-scale imaging, including inspection of lithography masks, atomic, molecular composition imaging with sub-100 nm resolution, and error-free nano-patterning will be reviewed.

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Jorge Rocca is a University Distinguished Professor in the Departments of Electrical and Computer Engineering and the Department of Physics at Colorado State University. His research interests are in the physics and development of compact EUV/soft-ray lasers and their applications, the development of high power lasers, and the study of high power laser interactions with matter, in particular with the goal of creating bright EUV/x-ray sources. His group is known for leading contributions to the development of bright table-top soft x-ray lasers, including the demonstration of the first table-top soft x-ray laser, and their application in several fields. Recently his group demonstrated the highest energy diode-pumped ultra-short pulse laser at 500 Hz repetition rate, and used it to demonstrate table-top soft x-ray lasers operating at increased repetition rates. He has published more than 250 peer-review journal articles in these topics that have accumulated more than 12,000 citations. Prof. Rocca received the Arthur. L. Schawlow Prize in Laser Science from the American Physical Society in 2011, and the Willis Lamb Prize for Laser Science and Quantum Optics in 2012. He is a Fellow of the American Physical Society, the Optical Society of America, and the IEEE. He also received an IEEE LEOS Distinguished Lecturer Award. Early in his career he was an NSF Presidential Young Investigator.

