

# Laser Produced Plasma Light Source for EUVL

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## ABSTRACT

This paper describes the development of laser-produced-plasma (LPP) extreme-ultraviolet (EUV) source architecture for advanced lithography applications in high volume manufacturing. EUV lithography is expected to succeed 193 nm immersion technology for sub-22 nm critical layer patterning. In this paper we discuss the most recent results from high qualification testing of sources in production. Subsystem performance will be shown including collector protection, out-of-band (OOB) radiation measurements, and intermediate-focus (IF) protection as well as experience in system use. This presentation reviews the experimental results obtained on systems with a focus on the topics most critical for an HVM source.

**Keywords:** EUV source, EUV lithography, Laser Produced Plasma

## 1. INTRODUCTION

EUV lithography is the front runner for next generation critical dimension imaging after 193 nm immersion lithography for layer patterning below the 32 nm node; beginning in 2013 according to the International Technology Roadmap for Semiconductors (ITRS). NAND Flash and DRAM devices are expected to have the need for this manufacturing technology as soon as 2012, with pilot line system introduction starting this year (2011). The availability of high power 13.5 nm sources has been categorized as high risk and ranked as critical with other technologies requiring significant developments to enable the realization of EUV lithography. High sensitivity photoresists with good line-edge-roughness (LER) and line-width-roughness (LWR) are needed to keep the required source power within reasonable limits. Photoresist sensitivity and other light absorbing elements are the basis to derive EUV source power requirements within the usable bandwidth (BW) of 2%. Scanner manufacturers are requiring clean EUV power of 250 W at the intermediate focus (IF) to enable >100 wph scanner throughput assuming 15 mJ/cm<sup>2</sup> photoresist sensitivity. The need for a Spectral Purity Filter (SPF) increases the requirements for Raw EUV power even higher. Clean EUV Power is calculated by taking the Raw EUV power and subtracting the losses associated with the SPF and dose control. For the current sources these losses are estimated to be 35% and 20%, respectively. A scalable EUV source architecture is needed to enable the evolution of EUV lithography during the life cycle of the technology. Laser-produced-plasma (LPP) sources are expected to deliver the necessary high power for critical-dimension high-volume manufacturing (HVM) scanners for the production of integrated circuits in the post-193 nm immersion era.<sup>1,2</sup>

A schematic of a source vessel is shown in Figure 1. An HVM I source is shown in Figure 2. Eight sources have been built and are operational, four of these have been shipped to customers. As described in details previously<sup>3-7</sup>, the HVM I sources use a 5 sr normal incidence collector, tin droplets of 30 microns diameter, and a ~30 kW (average power) CO<sub>2</sub> laser. The HVM I source is shown in its inclined position of 27 degrees as it is positioned when integrated into the scanner.

# Laser Produced Plasma Light Source For Euvl Cymer

**RJ Shavelson**



## **Laser Produced Plasma Light Source For Evl Cymer:**

EUV Sources for Lithography Vivek Bakshi,2006 This comprehensive volume edited by a senior technical staff member at SEMATECH is the authoritative reference book on EUV source technology The volume contains 38 chapters contributed by leading researchers and suppliers in the EUV source field Topics range from a state of the art overview and in depth explanation of EUV source requirements to fundamental atomic data and theoretical models of EUV sources based on discharge produced plasmas DPP and laser produced plasmas to a description of prominent DPP and LPP designs and other technologies for producing EUV radiation Additional topics include EUV source metrology and components collectors electrodes debris mitigation and mechanisms of component erosion in EUV sources The volume is intended to meet the needs of both practitioners of the technology and readers seeking an introduction to the subject *Nanomaterial Volume 4* Jyotsna Chauhan, There are four volume of this book series nanomaterial vol 1 2 3 4 The whole series covers the whole syllabus of MTech nanotechnology RGPV The main purpose of these books are to provide the complete syllabus of PG students at one place at very low cost EUV: Extreme Ultraviolet Lithography Genrikh Gel,2025-12-29 Unlock the secret force powering your world Imagine a breakthrough so powerful it allows us to literally print intelligence onto a sliver of silicon This is the story of the EUV machine a 150 million marvel that harnesses starlight to shape the future Discover how humanity conquered the atomic scale transformed manufacturing forever and unleashed a new era of technological possibility This isn't just engineering It's a triumph of human potential Ready to master the technology that's rewriting reality Your journey into the invisible revolution starts here China Semiconductor Technology International Conference 2010 (CSTIC 2010) Han-Ming Wu,2010-03 Our mission is to provide a forum for world experts to discuss technologies address the growing needs associated with silicon technology and exchange their discoveries and solutions for current issues of high interest We encourage collaboration open discussion and critical reviews at this conference Furthermore we hope that this conference will also provide collaborative opportunities for those who are interested in the semiconductor industry in Asia particularly in China **Selected Topics In Nanoscience And Nanotechnology** Andrew Thye Shen Wee,2009-06-23 Selected Topics in Nanoscience and Nanotechnology contains a collection of papers in the subfields of scanning probe microscopy nanofabrication functional nanoparticles and nanomaterials molecular engineering and bionanotechnology Written by experts in their respective fields it is intended for a general scientific readership who may be non specialists in these subjects but who want a reasonably comprehensive introduction to them This volume is also suitable as resource material for a senior undergraduate or introductory graduate course in nanoscience and nanotechnology The review articles have been published in journal COSMOS Vol 3 4 **Emerging Lithographic Technologies** ,2007 *Advanced Microlithography Technologies* Yangyuan Wang,Jun'en Yao,Christopher J. Progler,2005 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books

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**Emerging Lithographic Technologies VIII** ,2004 Digest of Technical Papers ,2001 *Summaries of Papers Presented at the Conference on Lasers and Electro-optics* ,2002 *Laser Focus World* ,2007 Global electro optic technology and markets Photonics technologies solutions for technical professionals worldwide **Technical Digest** ,2002 **Semiconductor International** ,2008 **Mass & Energy Efficient Tin Laser Produced Plasma Light Sources** ,2025 **Laser-generated Plasma as a Spectroscopic Light Source** ,1970 *Light Source Employing Laser-produced Plasma* ,2013 A system and a method of generating radiation and or particle emissions are disclosed In at least some embodiments the system includes at least one laser source that generates a first pulse and a second pulse in temporal succession and a target where the target or at least a portion the target becomes a plasma upon being exposed to the first pulse The plasma expand after the exposure to the first pulse the expanded plasma is then exposed to the second pulse and at least one of a radiation emission and a particle emission occurs after the exposure to the second pulse In at least some embodiments the target is a solid piece of material and or a time period between the first and second pulses is less than 1 microsecond e g 840 ns

**Advanced Source Studies on Laser Produced Plasmas for EUV Lithography** ,1995 Laser produced plasmas are source candidates for EUV lithography The radiation angular distribution for several target materials is investigated and source debris is characterized **Target Fabrication for Extreme Ultraviolet Laser Produced Plasma Sources** Evgenia McLoughlin,University College, Dublin. School of Physics,2009 **Applications of Laser Plasma Radiation** ,1995

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