EUV Lithography Short Course (June 7, 2026)

This course provides attendees with a full overview of the fundamentals, status, and technical challenges of EUV Lithography. Topics covered include EUV Sources, EUV Source Metrology, EUV Optics, EUV Systems and Patterning, and EUV Mask. We will begin with an overview of the history of EUVL and cover EUV sources, EUV source metrology and EUV optics, followed by a discussion of EUVL systems and patterning. We will cover the fundamental components of EUV systems and address similarities and differences in optical lithography systems. This section also covers patterning issues, including flare, LER, and resist performance. We will continue with an exploration of EUVL Mask technology issues such as design, materials (including reflective multilayers), process and metrology. Finally, we'll conclude with a Status Review of EUVL.

Registration Link

Please visit www.euvlitho.com/shop

Course Material

Students will be sent a E-Textbook copy of the course textbook, EUV Lithography (2nd Edition, SPIE Press, 2018), directly from SPIE, after the short course. If you will prefer to instead receive a printed copy of the book, please write to us at admin@euvlitho.com

Learning Outcomes

Course attendees will be able to increase their fundamental understanding of:

- History and basics of EUV Lithography, Key components in EUV systems, current status and technical challenges
- Different EUV source types and current technical challenges of EUV source technology, including EUV source metrology
- EUV and High-NA EUV scanners
- EUV optics, EUV patterning and EUV Resists
- EUV mask technology and current technical challenges

Intended Audience

This short course is intended for anyone who is involved in the development of EUV Lithography and/or other emerging lithography techniques; needs to understand the current technology status of EUV Lithography; and is interested in learning the fundamentals of this leading NGL patterning technology. Those who are responsible for the development of the roadmap for lithography in manufacturing and making technology decisions, as well as engineers and investors, will find this course valuable.

Detailed Course Outline

Module 1: Introduction to EUVL (Vivek Bakshi, *EUV Litho, Inc.*)

- Introduction to Lithography
- Moore's Law and ITRS
- Cost of Ownership
- Advantages of EUVL
- Key differences from 193 nm lithography
- List of Technical Challenges and Status
- Options beyond High NA Lithography

Module 2: EUV Sources (Vivek Bakshi, *EUV Litho, Inc.*)

- EUV Source Technology Overview
- Definition, Overview, Joint Requirements
- Types of Source Technologies o Laser-produced plasma (LPP) ○ Fundamentals of LPP ○ Components of Sn LPP Source ○ EUV Power Scaling ○ Pre-pulse technology ○ EUV Collector and Debris Mitigation ○ Out-Of-Band Radiation o Discharge-produced plasma (DPP)
  - Fundamentals of DPP
  - Components of Sn DPP Source
  - Collector and Debris Mitigation
- Source Metrology
- Source Technology Status and Future Outlook

Module 3: EUV Mask (Sangsul Lee, *POSTECH*)

- EUV mask structure and process flow
- Mask substrate
- Multilayer mirror deposition
- Absorber stack and pattern fabrication
- Mask inspection, metrology and repair
- Mask contamination protection and cleaning
- Advanced mask structure for better imaging

Module 4: EUVL and High NA EUVL Scanners (Jan B.P. van Schoot, *ASML*)

- Architecture of the current EUV and next generation high-NA EUV scanners
- Comparison of EUV exposure tools with DUV/DUV-immersion tools
- Reason for the high-NA anamorphic concept
- Current status and future roadmap

Module 5: EUVL Resists and Patterning (Patrick Naulleau, *EUV Tech*)

- Introduction
- EUV Optics
- EUV patterning capabilities and extendibility
- Current status of EUV resists
- EUV resists extendibility and shot noise

Module 6: Optics for EUV Lithography (Sebastian Brueck, Carl Zeiss SMT)

- Basic considerations and optics design for EUV
- Projection Optics Mirror Manufacturing
- Starlith 3400 and the highly flexible illuminator
- Photomasks inspection using AIMS™ EUV
- High-NA EUV next generation optical column
- Manufacturing challenges for high NA mirrors

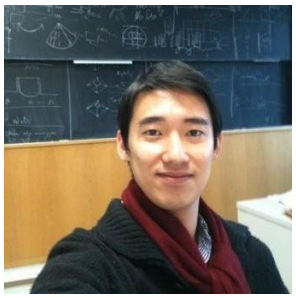
• Instructors for One-Day Short Course

• Vivek Bakshi (EUV Litho, Inc.)

Dr. Vivek Bakshi is the president of EUV Litho, Inc. an organization he has formed to promote EUV Lithography via consulting, publications, education and workshops. Previously he was a Senior Member of Technical staff in the Lithography Division of SEMATECH. He has edited four books on EUV Lithography: *EUV Sources for Lithography* (SPIE Press, 2006), *EUV Lithography* (SPIE Press and John Wiley & Sons, Inc., 2008), *EUV Lithography, Second Edition* (SPIE Press, 2018) and *Photon Sources for Lithography and Metrology* (SPIE Press, 2024). He is an internationally recognized expert on EUV Source Technology and EUV Lithography. He is the lead instructor for the course and the author of the EUV Source Technology chapter in the book *EUV Lithography* and *Photon Sources for Lithography and Metrology*.

- **Sangsul Lee (POSTECH)**

Dr. Sangsul Lee is a Senior Scientist at the Pohang Accelerator Laboratory (PAL) and an Affiliate Professor in the Department of Semiconductor Engineering at POSTECH. He has been actively engaged in research on EUV mask, resist, and actinic EUV metrology and inspection technology for approximately 20 years. Since 2020, he has been leading a project aimed at constructing a compact EUV synchrotron infrastructure at PAL, with a focus on establishing EUV-dedicated material and component testing infrastructure, as well as developing evaluation techniques.



- **Patrick Naulleau (EUV Tech)**

Dr. Patrick P. Naulleau is CEO of EUV Tech. He has been involved in EUV lithography since 1997 when he joined Lawrence Berkeley National Laboratory (LBNL) to work in the area of actinic interferometric alignment. At LBNL, he lead EUV Patterning project starting with the 0.1-NA ETS optics and then the 0.3-NA MET optic. He is internationally recognized for leading EUV patterning studies and his contributions to EUV System designs. He is the lead author of chapter on EUV Patterning in the book EUV Lithography.

- **Jan B.P. van Schoot (ASML)**

Dr. Jan B.P. van Schoot, is Director of System Engineering and Technical Specialist at ASML, based in Veldhoven, The Netherlands. After his study Electrical Engineering (Cum Laude) at Twente University of Technology. He received his PhD in Physics on the subject of non-linear optical waveguide devices in 1994 and held a post-doc position studying waveguide based electro-optical modulators.
He joined ASML in 1996 and was Project Leader for the Application of the first 5500/500 scanner and its successors up to 5500/750. In 2001 he became Product Development Manager of Imaging Products (DoseMapper, Customized Illumination). In 2007 he joined the dept of System Engineering. He was responsible for the Optical Columns of the 0.25NA and 0.33NA EUV systems. After this he worked on the design of the EUV source. He was the study leader of the High-NA EUV system and is now responsible for the High-NA optical train. He is a Fellow of the SPIE, holds over 35 patents and presents frequently at conferences about photolithography.

- **Sebastian Brueck (Carl Zeiss SMT)**

Dr. Sebastian Brueck is the Lead Systems Engineer for High-NA Optics at Carl Zeiss SMT GmbH. Prior to joining ZEISS in 2012, he specialized in soft-X-ray scattering and the characterization of thin film interfaces. At ZEISS, Sebastian initially worked in research and development for EUV metrology and coatings, contributing to advancements in measurement techniques and coating technologies. He then focused on manufacturing processes for EUV optics. Today, Sebastian and his team are developing processes for manufacturing the newest generation of High-NA EUV optic components.