

**EUVL Source Workshop
October 14, 2002
Intercontinental Hotel, Dallas, Texas, USA**

Executive Summary

The fifth Extreme Ultra-Violet Lithography (EUVL) Source Workshop was held October 14, 2002 in Dallas, Texas, USA at the Intercontinental Hotel. Meeting chairs were Patricia Gabella of AMD/International SEMATECH and Glenn Kubiak of Sandia National Laboratory. Over 130 people attended the EUVL source workshop, coming from lithography tool suppliers, EUVL source suppliers, semiconductor manufacturers, academia, and consortia.

Patricia Gabella gave a review of the agenda and what information was requested from the source suppliers for their presentations. Presenting for the three major lithography system suppliers – ASML, Canon, & Nikon -- Vadim Banine of ASML presented an update of the joint EUVL source requirements and provided a definition of the “clean photon spot” for quoting source requirements and measured performance. Fred Bijkerk of FOM gave an update on the metrology of Flying Circus II and the upcoming project plans. The metrology for out-of-band radiation measurement was presented by Rainer Lebert of AIXUV, and then Max Schürmann of Jenoptik gave an update on the progress in EUVL source metrology.

Seven EUVL source suppliers and one EUVL Source regional program gave update presentations on their EUVL source efforts: Cymer, Innolite, JMAR, Philips EUV, Plex, CEO/TRW, Xtreme Technologies & EUVA. These updates covered the two primary EUVL source technologies being used for EUV lithography, laser produced plasma (LPP) and gas discharge produced plasma (GDPP). Glenn Kubiak of Sandia National Laboratory reviewed the current knowledge of contaminating debris produced by EUVL sources and the associated debris generation mechanisms. Current techniques being applied or researched for debris mitigation were reviewed by Fred Bijkerk of FOM. Prof. Gerry O’Sullivan of the University of Dublin presented on the spectroscopy of a EUV laser plasma source. Some of the physical aspects of creating EUV light were discussed by Dr. Konstantine Koshelev of the Institute of Spectroscopy Russian Academy of Science.

There was a larger than expected attendance for this EUVL Source workshop, so splitting into breakout groups was deemed impractical. Instead, a general discussion of the EUVL source issues for full field EUV lithography systems was held with the entire audience. The audience agreed that the EUVL Source workshop was still focused on the right critical issues of power, metrology, debris & erosion, and thermal management. The audience was encouraged to focus on these issues and bring up suggestions of what areas of technology should be worked on by industry or presented at future meetings.

- For Collection optics
 - source supplier taking on this additional burden
 - no discussion at this meeting, different for LPP, GDPP; are there any mature approaches?
 - (maybe we should have a) 2 tier approach:
 - Tool design
 - Experimental setups
 - ? standardize (on a collection optic design)?
 - simple approach for experimental work, generic condenser
 - What are prospects for Multi-plex design with Multiple discharge sources?
 - (What is the) impact on condenser design?
 - Lifetime specification before the intermediate focus point
- For Power scalability
 - Example: lifetime data now measured @ low power; but how does it scale with increased power?
 - Continue investments to establish the fundamental limitations of the physics
 - Question to Gerry O'Sullivan; what is max conversion efficiency for
 - Xenon: 1.5%
 - Sn: maybe 3-4%
- For Thermal management
 - Topic needs to be in the talks
 - Good start
 - do not drop this topic yet from the workshop
 - LPP vs. GDPP
 - What are the other key areas that heat up and affect source operation, beyond the obvious?
 - (how is) C1 handling heat, as power rises?
- (What is) Pre-Competitive
 - Metrology tools @ supplier
 - building separate metrology tools
 - Suppliers – work to agree on metrology methods
 - ? what more do you need from Flying Circus?
 - Flying Circus could be expanded
 - Independent collection of data (good, helpful)
 - (Would like to see) More modeling

The group voted by show of hands that the EUVL Source Workshop should continue at a frequency of two times per year. Some of the recommendations for the next meeting for the supplier presentation content: understand the impact of the source on the lithography tool CoO, present actual source & consumables lifetime data and actual hours of source operation time (for any power source).

International SEMATECH will sponsor the next EUVL Source Workshop February 23, 2003 in Santa Clara, California. This will be held in conjunction with the SPIE Microlithography conference.

The chairs would like to acknowledge the help of the EUVL Source Workshop organizing committee, Vadim Banine of ASML and Fred Bijkerk of FOM and thank them. Their assistance was invaluable in getting this workshop organized, and locating the speakers to talk on the critical issues. And the organizers would like to thank the presenters at this EUVL source workshop, for the excellent content of the presentations and challenging the audience on the next steps for pursuing source capability that can support full field high throughput EUV Lithography systems.

EUVL Source Workshop October 14, 2002**Agenda**

8:00	Introduction	P. Gabella, AMD/ISMT
8:15	Update EUVL Source Requirements	V. Banine, ASML
8:35	Metrology & FC2 Planning	F. Bijkerk, FOM
8:55	Metrology, Out of Band Radiation	R. Lebert, AIXUV
9:15	Progress in Source Metrology	M. Shürmann, Jenoptik
Updates from Source Suppliers		
9:35	Cymer	I. Fomenkov
9:50	Innolite	B. Hanssen
10:05	<i>BREAK</i>	
10:30	JMAR	E. Turcu
10:45	Philips EUV	J. Pankert
11:00	Plex LLC	M. McGeoch
11:15	CEO/TRW	D. Moyer
11:30	Xtreme Technologies	U. Stamm
11:45	EUVA	A. Endo, Gigaphoton
12:00	<i>LUNCH</i>	
13:00	Debris Issues and Generation Mechanisms	G. Kubiak, SNL
13:20	Debris mitigation	F. Bijkerk, FOM
13:40	Spectroscopy of EUV Laser Plasma Source	Gerry O'Sullivan, University of Dublin
14:00	Some Physical Aspects of EUV Source Problem	Dr. Konstantine Koshelev, Institute of Spectroscopy Russian Academy of Science
14:30	<i>BREAK</i>	
15:00	Breakout topics: power, debris, thermal management, metrology	
	Instructions	
	Go to breakout	
16:15	Report on Breakout	
17:00	Adjourn	

(Note: breakouts did not occur due to the unexpected larger size of the audience. A discussion was held with the whole audience during the breakout period and the meeting adjourned about 16:30PM.)

Appendix – General Session Discussion in lieu of Breakout Session
EUVL SOURCE WORKSHOP Oct 14, 2002: FLIP CHART NOTES

?Are we focusing on the right topics at the EUVL Source Workshop?

YES – still critical issues for EUVL Sources

- Power
- Metrology
- Debris/erosion
 - Refine characterization of debris & erosion impacts on lifetime, include contamination
- Thermal management

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- Power scalability
 - ex: lifetime data @ low power, how it scales
 - Continue fundamental limitations of the physics
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Wrap-Up

- YES – continue the EUV Source workshop (vote, show of hands)
- Frequency: 2X/year (vote, show of hands)
- note: travel hard to get for 2X/year
- YES – continue supplier update – focus on 1-3 key issues

Next workshop

- pull source information back to tool CoO (what is source impact on tool CoO)
- Actual source & consumables lifetime data
 - any power (setting on the) source
 - actual hours of source operation time