

IEUVI Source TWG Meeting - San Jose, 2 March 2005

Regional Up-date

EUROPE

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MEDEA+

Regional Up-date - EUROPE

Outline:

- European EUV Programs and source projects
 - EC - IST
 - MEDEA+
- Results and achievements
- Conclusions

EUV Programs and Projects

	2001	2002	2003	2004	2005	2006	2007
MEDEA+	<div style="background-color: yellow; border: 1px solid black; padding: 5px; text-align: center;">EUV Tool</div> <div style="background-color: yellow; border: 1px solid black; padding: 5px; text-align: center;">EUV Sources: LPP, GDPP, Metrology 25M€</div> <div style="background-color: yellow; border: 1px solid black; padding: 5px; text-align: center;">EUV Masks</div>						
EC -IST	<div style="background-color: lightblue; border: 1px solid black; padding: 5px; text-align: center;">mGDPP, Optics, Resist 1,4M€</div> <div style="background-color: lightblue; border: 1px solid black; padding: 5px; text-align: center;">EUV Tool, Sources, Resist 23,3M€</div>						

EUV Programs and EUV Source Projects 1

○ EC - IST projects:

* Tool, Source, Resist:

- Basic work on 32nm - 22nm related issues

* Scalable components for EUV Lithography:

- Fundamental investigations and basic studies of principals, materials and designs of high rep. rate, high intensity micro discharge pulse plasma source
- Multi-layer collection and projection mirror optics
- Optics, Resist validation
- 2D simulations of high current discharge including radiation transport

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EUV Programs and EUV Source Projects 2

○ MEDEA+ EUV Source project:

- LPP: - MOPA (master oscillator, power amplifier) concept
 - Multiple module concept
 (both focussing on cw-diode pumping lasers)
- GDPP: - Z-pinch device
 - HTC (hollow cathode) device
- Collector: - Optical design, technology investigations
- Metrology: - EUV source characterization
 - Cross calibration of tools

Results and achievements

○ LPP Source:

- Investigation of solid state and CO₂ lasers (cost aspects), with focus on solid state lasers

- power and lifetime investigations:

- ⇒ 10 W in-band power into 2π sr

- ⇒ Laser power 1300 W

- ⇒ Repetition rates up to 25 kHz

- ⇒ $>5 \times 10^9$ pulses component lifetime

- ⇒ $>5 \times 10^9$ pulses optics life time

- ⇒ dose stability $\sigma = 0.45\%$

Results and achievements

○ LPP Source (continued):

- Definition of design for multiple laser beam transport and focussing, prototype assembly with multiplexing of up to ten lasers ongoing
- Various target transport systems investigated, target parameters studied, optimization of target w.r.t. total efficiency, debris and stability
- LPP source modeling and simulation \Rightarrow improved model, reduced computation time

Results and achievements

○ GDP Source:

- GDP sources supplied to EXITEC and ASML and installed at user sites
- Further power scaling \Rightarrow EUV power of 400 W into 2π sr
- Collector (lifetime related) investigations $\Rightarrow > 2 \times 10^9$ pulses collector lifetime
- Source component lifetime $\Rightarrow > 3 \times 10^8$ pulses
- Active dose control system \Rightarrow dose stability $\sim 0.2\%$
- IF quantification and metrology \Rightarrow total pulse energy per pulse, focus cross-section, angular distribution, et.al.
- Modeling program for numerical plasma modeling \Rightarrow Fast Numeric or Detailed Physics

Conclusions

- **First sources shipped and installed in tools and at users**
- **α - tool sources available**
- **Source power major improvements realized, good prospects for HVM tool**
- **Debris and lifetime significant progress, but still far from target**
- **Source supply chain still needs fundamental research work**
- **No final decision on preferred technology**