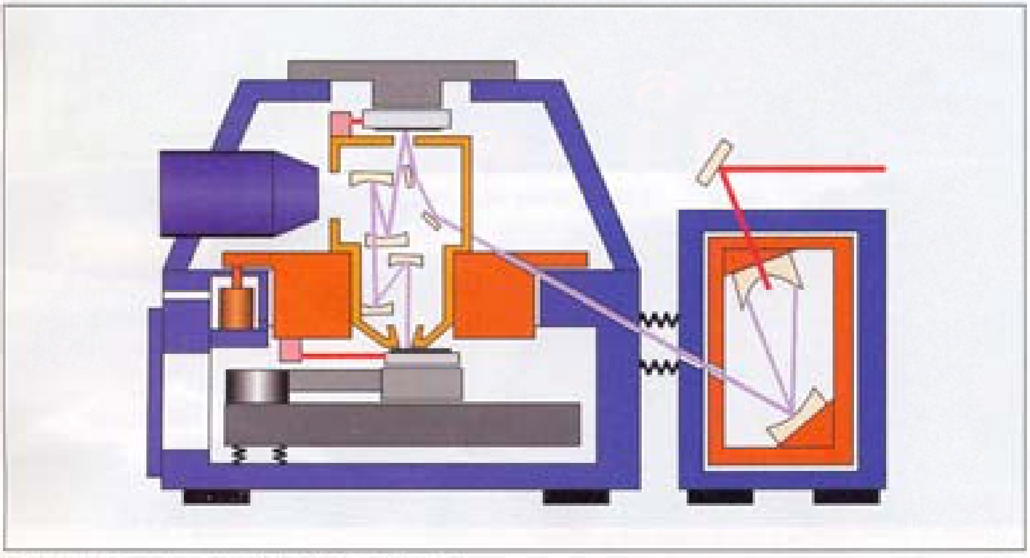
Europe Leads in Extreme UV Lithography



Schematic drawing of the EUV lithography tool
Right: Illuminator optics; **Left:** Six mirror demagnifying optics with mask at top and waferstage at bottom

Extreme UV Lithography (EUVL) will be the technique used to pattern ever more transistors of yet finer dimensions onto silicon chips towards the end of this decade. By then, chips will have feature sizes of 45nm and less, using patterns that cannot be produced by refractive optics. The vital importance of using the shorter EUVL wavelengths was demonstrated at the Medea+ Forum in Barcelona, Spain, in November.

Rob Hartman, of ASML, said Europe will dominate in EUVL by 2009 with an expected turnover of more than €1bn and about 18,000 employees, mainly at a higher technical level. Medea+ is a pan-European organisation that promotes research and development between companies and academics in projects taking place in at least two countries.

Until recently, a major problem has been that of generating adequate EUV power at the required 13.5nm wavelength to enable EUVL to be used for mass production. However, Hartman said, an EUV power level of 800W over 2-Pi steradians has been achieved at 4kHz. This is an increase of three orders of magnitude over three years, so power is no longer a major issue. The lifetime of the sources has also been increased by several orders of magnitude.

Aachen-based Philips has developed a source using gas discharge plasma containing xenon or tin. Göttingen-based Xtreme has produced both a gas discharge and a laser induced plasma source. However, collector lifetimes, masks and resists are still major problems in this work involving 13 collaborators in France, Germany, The Netherlands, Poland and Sweden. Critical issues include optics quality and life and reticle protection during storage, handling and use. Reflective optics using mirrors, coated with alternate layers of molybdenum and silicon are used, but it is vital to minimise losses at each mirror, as the EUV undergoes many reflections in the system.

Nevertheless, one full-field EUV tool will be shipped to research facility IMEC in Leuven, Belgium, and another to the University of Albany in the US, in the second quarter of 2006.

Another Medea+ project has led to the development of a mask for aligning and installing an EUV system. It can be fabricated in the AMTC (Advanced Mask Technology Centre) in Dresden and is already available.

MEDEA+ participants have already started a debate on a successor programme. The advanced co-operative R&D programme in microelectronics is coming to a close in 2008, but since it involves over 350 partners from 21 countries, it will take some time before the technical outline and funding for a similar programme are agreed. Prior to MEDEA+, MEDEA and before that JESSI helped advance Europe's capabilities in micro and nanoelectronics R&D and placed it firmly on the map in these fields. MEDEA+ started in January 2001 with the remit to focus on system innovation on silicon for the e-economy.

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The Centre for Integrated Photonics (CIP) has developed a reflective semiconductor optical amplifier offering highly optimised performance for WDM passive optical network (PON) applications. Capable of delivering a gain of 20dB, the semiconductor optical amplifier (SOA) can be modulated at rates up to 1.5Gbit/s to provide wavelength-agile optical data transmission for fibre-to-the-home/premises (FTTH/FTTP) access network architectures – without the expense of a tunable wavelength source. Novel curved waveguide architecture inside the monolithic InP (indium phosphide) based SOA delivers smooth output characteristics with a ripple of just 0.5dB (typical) and a polarisation-dependent gain of 1.5dB. This performance is claimed to be unique on the market and it will boost the development of cost-effective WDM PONs.

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Students at the De Montfort University in Leicester are learning about the next generation of television technology in a unique £300,000 high-definition TV lab, where academics are also conducting a multi-million pound research to develop 3-D TV. The new HDTV lab includes a £23,000 DVB/ATSC combined encoder and multiplexer for processing multiple data streams. The students are also using real-time high-definition editing facilities as well as high-definition cameras, which will soon be used by TV crews around the UK. The research for this project is funded by a 'Network of Excellence' grant from the European Union.