PROJECT PROFILE

T406: Extreme UV consortium for imaging technology (ExCITe)

PROCESS EQUIPMENT

Partners:

ASML
Carl Zeiss SMT
CEA-LETI
Clariant
CNRS-LTM
ELDIM
Infineon
IMEC
Motorola
INFM-TASC
Philips
SAGEM
STMicroelectronics

Project leader:

Peter Zandbergen,
Philips

Key project dates:

Start: January 2003
End: December 2005

Countries involved:

Belgium
France
Germany
Italy
The Netherlands

Several European companies are working with next-generation, extreme ultra violet (EUV) imaging technology to create new equipment and techniques for patterning chips. The objective of the MEDEA+ T406 ExCITe project is to create the necessary techniques to process patterns, just 45nm wide, on to silicon wafers of the new generation of chipsets by 2007. Successfully implementing EUV lithography will enable projection photolithography to remain the semiconductor manufacturing industry's patterning technology of choice for years to come, and create the opportunity for Europe to become a centre for EUV technology. The ExCITe project will therefore have a major impact on jobs in Europe.

According to the so-called 'Moore's Law', the number of transistors in an integrated circuit (IC) should double every 18 months, and this is expected to continue in the near future. This increase in the number of functions per unit area was due to a very large extent to the immense progress in lithography techniques. Optical projection lithography uses light to print the intricate patterns that define ICs on a semiconductor wafer. Typically, a pattern on a mask is imaged, with a reduction of 4:1, by an extremely accurate exposure tool on to a silicon wafer coated with photoresist.

Today, printing of 130nm feature sizes is state-of-the-art in manufacturing, while 90nm CMOS technology has entered into pilot production. Over the next few years, industry has to decide which lithographic technology it is going to use if it is to produce future generations of chips at the 45nm and 32nm technology nodes.

To keep pace with the demand for printing ever-smaller features, lithography tool manufacturers have reduced the wavelengths of the light used for imaging (436nm, 365nm, 248nm, 193nm, 157nm) and have designed projection lenses with ever-larger numerical apertures. Now there are a few potential successors to optical projection lithography – so-called next-generation lithographies (NGLs). Industry will need a prototype exposure tool of one of these alternative methods at the latest by 2005.

Extreme ultra violet (EUV) lithography is leading the race to become optical lithography's successor. EUV is considered to be the only viable option for the 32nm node and a fallback option for the 45nm technology generation as well. EUV lithography is a natural extension of optical projection lithography since it also uses electromagnetic radiation but at a very short wavelength (13nm) to carry out projection imaging.

Tough competition

Intel had formed the EUV LLC consortium, which includes AMD, Infineon, IBM, Micron and Motorola, to support the development of EUV-specific technologies. Three US national laboratories – Lawrence Berkeley, Lawrence Livermore and Sandia – working together as the Virtual National Laboratory (VNL) carried out the bulk of this work. Industrial consortium members mainly work on mask fabrication and photoresist development.

In the Far East, ASET is developing a proto-

type EUV production tool for 2004. While ASET intends to continue these activities concentrating more on EUV process technology and metrology, the recently established EUVA consortium is focusing on EUV sources and the development of an exposure tool.

The necessary, revolutionary and very risky innovations in this type of lithography therefore require powerful, pan-European co-operation, which involves all the available resources of the user and supplier industries, specialised institutes and universities. The MEDEA+ T406 ExCITe project is pulling together semiconductor manufacturers (Infineon, STMicroelectronics, Philips and Motorola), a group of equipment and materials companies (ASML, Carl Zeiss, Clariant, ELDIM and SAGEM) and institutes (CEA-LETI, IMEC, CNRS-LTM and INFM-TASC) to develop the various elements of the EUV lithography process that will be needed to print feature sizes 45nm and below onto silicon wafer.

ASML is a leading European supplier of EUV lithography equipment. CEA-LETI has recently completed the French national EUV research project PREUVE with its partners. This produced the first European EUV imaging tool – BEL – which will be used for further research and served as ExCITe's starting point. The MEDEA+ project also builds on the results and knowledge gained in a past ESPRIT project – EUCLIDES.

IMEC's reputation in lithography process development is strong, based on the institute's successful programmes, in which it has investigated three consecutive lithography generations (248nm, 193nm and 157nm). Clariant is a major European photoresist supplier, and is conducting a world-class programme into EUV resist development.

The project consortium formed by these and other partners – tool and materials suppliers, industrial users, and supporting research institutes – is ideally suited to the task of developing and implementing EUV imaging technology.

Maintaining global position

Because of the close co-operation with lithography-related suppliers, European semiconductor manufacturers STMicroelectronics, Infineon and consortium leader Philips have succeeded in containing and even improving their positions in the global top ten over the past decade. Working with Motorola, these industrial partners will apply the results of the project in their manufacturing processes, starting with the 45nm CMOS generation of chips, which is expected to enter production in 2007.

Carl Zeiss is primarily responsible for supplying the optical components of the ASML systems. During the project, Carl Zeiss will also assess whether parts of the optical system could be manufactured more widely at a later stage by SAGEM, so that the project's EUV expertise can be made available across Europe.

The results obtained by CNRS-LTM will be disseminated through scientific publications in conferences – including the SPIE conference on Microlithography, which is the most important meeting in the field, or the MNE conference in Europe – and reviewed journals such as the *Journal of Microlithography, Microfabrication, & Microsystems.*

ExCITe will increase Europe's expertise in the field of lithography simulation. This knowledge will be passed among the consortium's industrial partners during and after the project via contracts, informal exchange or advice. This expertise will be very important if Europe is to attract and train students in the field of lithography and provide well-trained engineers for the semiconductor industry. The improvement of the simulation codes that will be developed within ExCITe can potentially be transferred to a commercial software vendor.

Early access to technology

Successful implementation of EUV lithography would enable projection photolithography to remain the semiconductor industry's patterning technology of choice for years to come. Know-how developed in the MEDEA+ EUV cluster of projects – in particular EUV tools (T403 EXTATIC), EUV sources (T405 EUV Sources), masks (T404 EXTUMASK) and development of EUV imaging capabilities including modelling and metrology (T406 ExCITe) – is creating the opportunity for Europe to become the centre of EUV technology.

Operating in a high-cost environment, early access to advanced lithography technology is vital if European chipmakers are to remain competitive. In the second half of this decade, EUV technology will be of great importance if the European IC industry is to maintain or even improve its global position. The MEDEA+ ExCITe project will therefore have a major impact on jobs in Europe.

MEDEA+

MEDEA+ Office
33, Avenue du Maine
Tour Maine-Montparnasse
PO Box 22
F-75755 Paris Cedex 15, France
Tel.: +33 1 40 64 45 60
Fax: +33 1 40 64 45 89
Email: medeaplus@medeaplus.org
http://www.medeaplus.org

EUREKA Σ!

MEDEA+ Σ!2365 is the industry-driven pan-European programme for advanced co-operative R&D in microelectronics to ensure Europe's technological and industrial competitiveness in this sector on a worldwide basis.

MEDEA+ focuses on enabling technologies for the Information Society and aims to make Europe a leader in system innovation on silicon for the e-economy.