

Review

The 22nd Annual EMLC 2006 Took Place in Dresden This January With Record Attendance

Like the conferences in 2004 and 2005 the 22nd European Mask and Lithography Conference, EMLC2006 was held in Dresden this year.

Attendance consisted of 250 mask and lithography experts as well as 28 technical Exhibitors from January 23 to 26, 2006.

The three-day conference is dedicated to the science, technology, engineering, and application of mask and lithography technologies and associated processes. It gives an overview of the present status in mask and lithography technologies as well as future strategies for photomask makers. It also provides an opportunity for mask producers and users to become acquainted with new developments and results. This year's conference focused on the important fields of photomask lithography Technologies and manufacturing processes. Beside sessions on Advanced Lithography and Simulation, Metrology, DFM&MDP, Mask Making, Mask Repair and Mask Cleaning, and EUV we organized a session for Nano Imprint Lithography because of the growing interest in this technology. Thursday there were two sessions on Immersion Lithography, both organized with the support of IMEC.

The EMLC has not grown to such a point (yet) where parallel sessions are necessary. This year the program committee accepted 58 papers. For the first time there were more papers submitted from outside Europe than within. There were thirty papers from the USA, Canada, Japan, Korea, and Taiwan. Twenty-eight were from Europe including Belarus and Russia. The biggest contributor was the USA.

We had seventy-eight companies involved in generating the papers as authors and presenters. We feel this demonstrates a worldwide, intensive and interactive cooperation between many companies.

As conference welcoming speaker we invited Ministerialdirigent Joerg Geiger, Head of the Research Department in the Saxon State Ministry of Science and Fine Arts. As Keynote Speaker we invited Dr. Kuecher from the Fraunhofer Center Nanoelectronic Technology, CNT, in Dresden. He talked about "The Nanoelectronic Challenge – CNT a New Approach for Research and Manufacturing".

What is the CNT?:

The Fraunhofer Center Nanoelectronic Technology CNT is exemplary for a new way of interlocking research science and production. The CNT expands the Fraunhofer's alliance of microelectronic's competencies in cooperation with leading semiconductor manufacturers in the field of technology development. As such, the CNT is part of the European initiative ENIAC (European Nanoelectronic Initiative Advisory Council) that was created to strengthen the field of nano-electronics. The organization is a bit like IMEC in Belgium, and LETI in France. One of the CNT's missions is to collaborate directly with industry.

The partners consist of the Fraunhofer-Gesellschaft, Infineon Technologies AG, and Advanced Micro Devices Inc. AMD. These industry participants also work in conjunction with the German Federal Government and the Free State of Saxony. A memorandum of understanding was signed by the participants establishing the CNT. "For the CNT there are 800 m² of cleanroom facilities available as well as an infrastructure that complies with industry standards," says Dr. Peter Kücher, the CNT's director. The CNT's goal is to make maximum usage of the synergies between science, development and the manufacturing of process technologies for nano-electronics at the facility in Dresden. The CNT is located adjacent to the Infineon manufactory facilities in Dresden.

With Infineon's 300-mm DRAM production already under way, and AMD's two microprocessor facilities Dresden offers excellent conditions for a cooperative research platform for nano-electronics. In the CNT's clean-room facilities. The industry partners Infineon and AMD, in cooperation with Fraunhofer researchers, the technical University of Dresden, and other institutes, will be able to develop process technologies for the manufacturing of nano-electronics. The CNT is open to further cooperation with materials and equipment manufacturers.

Industry partners and government will again invest a total of 700 million Euro in the expansion of the nanoelectronics location Germany. One third of these funds will be provided by the German confederation, the Free State of Saxony and the EU. Besides building expenses the BMBF and the Free State of Saxony are supporting the new Fraunhofer facility with institutional funds totaling 80 million Euro to be paid over the next five years, intended for the purchase of basic equipment. In this period the industry partners are planning to invest 170 million Euro in research projects. These will be funded with 85 million Euro by the BMBF, the Free State of Saxony and the EU commission.

More good news from Dresden

AMD has concentrated all its microprocessor manufacturing in its Dresden site. Assuming an overall market share of about 20% that means that every 5th microprocessor used on our planet could be produced in Dresden. This is also the location where AMDs most sophisticated Dual-Core Microprocessor are manufactured. AMD runs two Fabs in Dresden: AMD Fab 30 where microprocessors are produced on 200 mm wafers in the 90nm technology, and AMD Fab 36 which has just ramped up 300 mm wafer production. In the first half of 2006, AMD Fab 36 will deliver microprocessors to the world market. In the second half of 2006, Fab 36 will introduce the 65 nm node technology. In AMD Fab 36 the third generation of AMD's production principle, the "Automated Precision Manufacturing (APM 3.0)" will be used.

AMD is one of the biggest international investors in Germany over the last ten years, with \$ 4.9 Billion planned to be invested up until 2007. Fab 36 alone accounts for up to \$ 2.5 billion in expenditures. AMD Dresden employs about 2,800 people and will increase this number to 3,000 by mid 2006. This number includes about 1,000 new employees for Fab 36.

These outstanding technologies are not possible without the highly sophisticated reticles manufactured in the Advanced Mask Technology Center (AMTC), that is just around the corner in Dresden. This mask house owned by Toppan Photomasks, AMD and Infineon. It produces and delivers the advanced reticles used daily by AMD and Infineon. The secondary priority for the AMTC is the development of new generation photomasks for the 65nm and 45nm generations. As a result Dresden is now one of the High Technology centers of Europe. Others high technology centers include IMEC in Leuven, Belgium and LETI in Grenoble, France.

A few Comments About the specific papers presented at the EMLC2006

I am pleased to inform you that the **EMLC 2006 BEST PAPER Award** was:

A Correlation for Predicting Film-Pulling Velocity in Immersion Lithography

Presented by Scott Schuetter, University of Wisconsin, United States. The co-authors are Timothy Shedd, University of Wisconsin, Keith Doxtator, University of Wisconsin, Gregory Nellis, University of Wisconsin, and Chris Van Peski, SEMATECH.

This is the second time in three years (2003), that one of the experts of Prof. Roxann Engelstad's Department of Mechanical Engineering has won the award, congratulations.

This paper has been invited to be presented at the Photomask Japan Conference in April 2006 in Yokohama.

The **second best paper** was awarded to:

Using Design Intent to Qualify and Control Lithography Manufacturing

Jim Vasek, Bill Wilkinson, Dave Smith, Al Reich, Cesar Garza, Freescale Semiconductor, USA, Jim Wiley, Joyce Zhao, Brion Technologies, USA, Moshe Poyastro, Brian Troy, Youval Nehmadi, Zamir Abraham, Applied Materials, USA.

The award for the **third best paper** was a tie and has been awarded to the following two papers:

Analysis method to determine and characterize the mask mean-to-target and uniformity specification

Sung-Woo Lee, Leonardus H.A. Leunissen*, Jeroen Van de Kerkhove*, Vicky Philipsen*, Rik Jonckheere*,

Suk-Joo Lee, Sang-Gyun Woo Han-Ku Cho and Joo-Tae Moon Process Development Team,
Samsung Electronics, San #24, Nongseo-Ri, Giheung-Eup, Yongin-City, Gyeonggi-Do, 499-711, Korea
*IMEC, Kapeldreef 75, B-3001, Leuven, Belgium

and

Sub-110 nm line width standards for accuracy calibration of CD-SEM and CD-AFM

Sanjay Shirke¹, Gian Lorusso², René Blanquies¹, Tom Vandeweyer³

¹ VLSI Standards, Inc., 3087 N. First Street, San Jose, CA 95134; ² KLA-Tencor Corp., 160 Rio Robles, San Jose, CA 95134; ³ IMEC, Kapeldreef 75, 3001 Leuven, Belgium

During the conference we also presented an **EMLC2006 BEST POSTER Award**. This was awarded to:

CD and Profile Metrology of Embedded Phase Shift Masks Using Scatterometry

Kyang man Lee, Malahat Tavassoli, Kiho Baik, Intel Corporation, Santa Clara, USA; Sanjay Yedur, Timbre Technologies, Santa Clara, USA; Dave Hetzer, Timbre Technologies, Dresden, Germany

Again, congratulations to all authors

What did we learn at the EMLC2006 regarding mask and lithography techniques?

NIL (Nano-Imprint Lithography or "Mechanical Lithography") is a promising technology and we listened to the technology status in the very interesting NIL session. In SEMI there is already a group of 20 companies discussing the standardization of template form factor issues. Our initial meeting took place at the SEMI Micro-patterning Technical Committee (where Jacques Waelpoel from ASML and myself are the co-chairs) at SEMICON Europe 2005 in Munich. It was then continued at the SEMI autumn meeting in Leuven in November 2005, and was continued at SEMICON Japan in December 2005 in Makuhari. Some people already see NIL as a candidate for the 32nm node, well let's wait and see.

We learned that EUV is continuing even though there were not many papers submitted or presented regarding EUV.

The ArF₂ immersion lithography ($\lambda = 193\text{nm}$) is the latest "up and coming" lithography technique. It has already passed the emergence status and will be used in production soon.

At the EMLC 2006 two papers were presented on changing reticles from 6" to 8."

EMLC2007 in Grenoble France next year?

We got a very serious offer from LETI, MINATEC and SITELESC to organize the EMLC2007 in Grenoble. We plan to visit Grenoble this month (March) to learn more about this location and the conference facilities. If we decide to hold the EMLC2007 in Grenoble we hope you will attend, it is a high-tech area and a beautiful location close to the Alpine Mountains.

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