

# 2017 Source Workshop

November 6-8, 2017  
Dublin ■ Ireland

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## Workshop Agenda



# 2017 Source Workshop

## Workshop Co-Organizers



# Welcome

Dear Colleagues;

I am delighted to invite you to the 2017 Source workshop in Dublin, Ireland.

Source workshop, now in its 8<sup>th</sup> year, is the largest annual gathering of EUV and XUV source experts and this meeting continues to grow! This year we are including new topics of broad-band EUV sources and lasers, as these topics have become important for continued success of EUV Lithography. As always workshop will provide a forum for researchers in the EUV and soft X-ray areas to present their work and discuss potential applications of their technology. The workshop proceedings will be published online and made available to all.



This year, the EUV Source Workshop is organized by University College Dublin (UCD) and EUV Litho, Inc. This workshop has been made possible by the support of workshop sponsors, technical working group (TWG), workshop support staff, session chairs and presenters. I would like to thank them for their contributions and making this workshop a success. I look forward to your participation in the workshop.

Best Regards

Vivek Bakshi  
Organizing Chair, 2017 Source Workshop

## 2017 Source Workshop

### Source Technical Working Group (TWG)

Reza Abhari (ETH Zurich)  
Jinho Ahn (Hanyang University)  
Peter Anastasi (Silson)  
Sasa Bajt (DESY)  
Igor Fomenkov (ASML)  
Klaus Bergmann (ILT-Fraunhofer)  
Davide Bleiner (University of Bern)  
John Costello (DCU)  
Padraig Dunne (UCD)  
Samir Ellwi (ALSphotronics)  
Akira Endo (HiLase)  
Henryk Fiedorowicz (Military University of Technology, Poland)  
Torsten Feigl (OptiXfab)  
Debbie Gustafson (Energetiq)  
Ahmed Hassanein (Purdue)  
Takeshi Higashiguchi (Utsunomia University)  
Larissa Juschkin (Aachen University)  
Hiroo Kinoshita (Hyogo University)  
Konstantin Koshelev (ISAN)  
Rainer Lebert (Bruker)  
Peter Loosen (ILT-Fraunhofer)  
Eric Louis (University of Twente)  
James Lunney (Trinity College, Dublin)  
John Madey (University of Hawaii)  
Shunko Magoshi (EIDEC)  
Hakaru Mizoguchi (Gigaphoton)  
Udo Dinger (Carl Zeiss)  
Katsuhiko Murakami (Nikon)  
Patrick Naulleau (LBNL)  
**Oscar Versolato (ARCNL)**  
Fergal O'Reilly (UCD)  
Gerry O'Sullivan (UCD)  
Yuriy Platonov (RIT)  
Martin Richardson (UCF)  
Jorge Rocca (University of Colorado)  
David Ruzic (University of Illinois)  
Akira Sasaki (JAEA)  
Leonid Shmaenok (PhysTex)  
Emma Sokell (UCD)  
Hironari Yamada (PPL)  
Mikhail Yurkov (DESY)  
Sergey Zakharov (NAEXTSTREAM)  
Vivek Bakshi (EUV Litho, Inc.) - Organizing Chair  
Padraig Dunne (UCD)- Co-Chair

# Workshop Agenda

# 2017 Source Workshop

## Agenda Outline

### Monday, November 6, 2017

**Location: Ardmore House, UCD Campus Dublin**

<http://www.ucd.ie/crhservices/ardmore-house/>

5:30 - 7:00 PM

On-site Registration  
Reception and Speaker Prep

*Bus Pickup at*

*Newman House (Time to be announced -TBA)*

<http://www.ucd.ie/conferences/venues/newman-house/>

*Mespil (TBA)*

<http://www.mespilhotel.com/>

*Stillorgan Park (TBA)*

<http://www.talbothotelstillorgan.com/>

Please plan to be at one of these locations which is close to your hotel. Buses will be available to take attendees back to Newman house, Mespil Hotel and Stillorgan Park after the reception

### Tuesday, November 7, 2017

**Location: George Moore Auditorium, UCD Campus, Dublin**

8:15 AM

Bus Pickup

*Newman House (TBA)*

*Mespil (TBA)*

*Stillorgan Park (TBA)*

## 2017 Source Workshop

8:45 AM -9:15 AM      Tea/Coffee and Biscuits  
Registration

9:15 AM – 1:00 PM    Workshop Presentations

1:00 PM – 2:00 PM    Lunch

2:00 PM – 5:20 PM      Workshop Presentations

5:40 PM – 7:00 PM      Poster Session

(Buses will be available to take workshop attendees to downtown after the poster session – Stillorgan, Mespil and Newman House)

## Wednesday, November 8, 2017

**Location: George Moore Auditorium, UCD Campus, Dublin**

8:15 AM                      Bus Pickup  
*Newman House (TBA),  
Mespil (TBA),  
Stillorgan Park (TBA)*

8:45 AM -9:15 AM      Tea/Coffee and Biscuits

9:15 – 1:00 PM          Workshop Presentations

1:00 PM - 2:30 PM      Lunch (Cafeteria)  
Working Steering Committee Meeting (TBA)

2:30 PM – 6:00 PM      Oral Presentations

6:15 PM                      Depart for off-site Dinner

(Buses will be available to take participants to the off-site dinner location near downtown Dublin. Buses will take people back to their hotels.)

# WORKSHOP AGENDA

## 2017 Source Workshop

November 6-8, 2017, Dublin, Ireland

### Monday, November 6, 2017 (Ardmore House, UCD Campus)

5:30 - 7:00 PM Reception and Speaker Prep

### Tuesday, November 8, 2017 (George Moore Auditorium, UCD Campus, Dublin)

#### 9:15 AM Announcements and Introductions

##### Welcome -2017 Source Workshop

Vivek Bakshi  
*EUV Litho, Inc., USA*

##### Welcome to UCD

Orla Feely  
*UCD*

##### Announcements and Introductions (Intro-1)

Padraig Dunne  
*UCD*

#### 9:40 AM Session 1: Keynote Session -1

**Session Chair:** Padraig Dunne (UCD)

##### **EUV Source for High Volume Manufacturing: Performance at 250 W and Key Technologies for Power Scaling (S1) (Keynote Presentation)**

Igor Fomenkov  
*Cymer LLC, An ASML Company, San Diego, CA 92127, USA*



**10:40 AM      Session 2: Fundamental Data**

**Session Chairs:**

**Tin Ion Spectroscopy on Plasma Sources of EUV Light (S14)**

Ronnie Hoekstra

*Advanced Research Center for Nanolithography (ARCNL), Science Park 110, 1098 XG Amsterdam, the Netherlands and*

*Zernike Institute for Advanced Materials, University of Groningen, 9747 AG Groningen, the Netherlands*

**Atomic Data of Low-charged Sn ions for Lithography Applications (S11)**

*J. Colgan, D. P. Kilcrease, J. Abdallah, Jr., M. E. Sherrill, C. J. Fontes, and P. HakeL Los Alamos National Laboratory, Los Alamos, NM 87545*

**EUV Spectra of Highly Charged-ions Observed with a Compact Electron Beam Ion Trap (S12)**

*Nobuyuki Nakamura<sup>1</sup>, Safdar Ali<sup>1</sup>, Hiroyuki Kato<sup>1</sup>, and Emma Sokell<sup>2</sup>*

*<sup>1</sup>Institute for Laser Science, the University of Electro-Communications, Tokyo 182-8585, Japan*

*<sup>2</sup>School of Physics, University College Dublin, Belfield, Dublin 4, Ireland*

**Fundamental Studies of Sn<sup>7+</sup>-Sn<sup>14+</sup> Ions with Applications for Laser Produced Plasma Sources (S13)**

*H. Bekker (1), F. Torretti (2, 3), A. Windberger (1, 2), A. Borschevsky (4), A. Ryabtsev (5, 6), S. Dobrodey (1), E. Eliav (7), U. Kaldor (7), E. V. Kahl (8), J. C. Berengut (8), W. Ubachs (2, 3), R. Hoekstra (2, 9), J. R. Crespo Lopez-Urrutia (1), and O. O. Versolato (2)*

*1 Max-Planck-Institut fur Kernphysik, Heidelberg, Germany*

*2 Advanced Research Center for Nanolithography, Amsterdam, The Netherlands*

*3 Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit, Amsterdam, The Netherlands*

*4 Van Swinderen Institute, University of Groningen, Groningen, The Netherlands*

*5 Institute of Spectroscopy, Russian Academy of Sciences, Troitsk, Moscow, Russia*

*6 EUV Labs, Ltd., Troitsk, Moscow, Russia*

*7 School of Chemistry, Tel Aviv University, Tel Aviv, Israel*

*8 School of Physics, University of New South Wales, Sydney, Australia*

*9 Zernike Institute for Advanced Materials, University of Groningen, Groningen, The Netherlands*

**11:40 AM      Break (20 Minutes)**

**12:00 PM                      Session 3: Lasers**

**Session Chairs:**

**High Average Power and High Energy Ultrafast Thin-Disk Amplifiers (S31)**

Thomas Metzger

*TRUMPF Scientific Lasers GmbH & Co. KG, Feringastr. 10a, 85774 Unterföhring, Germany*

**High-harmonic Generation for Metrology Applications (S32)**

Johannes Weitenberg [1,2], Ioachim Pupeza [1,3], Akira Ozawa [1], Tobias Saule [3], Jan Schulte [2], Hans-Dieter Hoffmann [2], Thomas Udem [1], Peter Rußbüldt [2], Reinhart Poprawe [2,4], Theodor W. Hänsch [1,5]

*[1] Max-Planck Institute of Quantum Optics, Hans-Kopfermann-Str. 1, 85748 Garching, Germany*

*[2] Fraunhofer Institute for Laser Technology, Steinbachstr. 15, 52074 Aachen, Germany*

*[3] Ludwig-Maximilian University Munich, Faculty of Physics, Chair of Experimental Physics - Laser Physics, Am Coulombwall 1, 85748 Garching, Germany*

*[4] RWTH Aachen University, Chair for Laser Technology, Steinbachstr. 15, 52074 Aachen, Germany*

*[5] Ludwig-Maximilian University Munich, Faculty of Physics, Chair of Experimental Physics, Schellingstr. 4/III, 80799 München, Germany*

**Development of kW-level Picosecond Thin-disk Pre-pulse Laser for High-power EUV Sources (S33)**

J. Mužík, M. Smrž, M. Chyla, O. Novák, A. Endo, T. Mocek

*HiLASE Centre, Institute of Physics CAS,*

*Za Radnicí 828, 252 41 Dolní Břežany, Czech Republic*

**1:00 PM                      Lunch (60 Minutes)**

**2:00 PM      Session 4: High Power LPP Sources for HVM**

**Session Chairs:**

**High Power LPP-EUV Source with Long Collector Mirror Lifetime for High Volume Semiconductor Manufacturing (S41)**

Hakaru Mizoguchi, Hiroaki Nakarai, Tamotsu Abe, Krzysztof M Nowak, Yasufumi Kawasuji, Hiroshi Tanaka, Yukio Watanabe, Tsukasa Hori, Takeshi Kodama, Yutaka Shiraishi, Tatsuya Yanagida, Georg Soumagne, Tsuyoshi Yamada, Taku Yamazaki and Takashi Saitou

*Gigaphoton Inc. Hiratsuka facility*

*3-25-1 Shinomiya Hiratsuka Kanagawa, 254-8567, JAPAN*

**Two-dimensional Electron density and Temperature Profiles of EUV Light Sources with 4.0% CE (S42)**

Kentaro Tomita<sup>1</sup>, Yuta Sato<sup>1</sup>, Syoichi Tsukiyama<sup>1</sup>, Raimu Fukada<sup>1</sup>, Fumitaka Ito<sup>1</sup>, Kiichiro Uchino<sup>1</sup>, Kouichiro Kouge<sup>2</sup>, Tatsuya Yanagida<sup>2</sup>, Hiroaki Tomuro<sup>2</sup>, Yasunori Wada<sup>2</sup>, Masahito Kunishima<sup>2</sup>, Takeshi Kodama<sup>2</sup>, Hakaru Mizoguchi<sup>2</sup>

<sup>1</sup> *Interdisciplinary Graduate School of Engineering and Sciences, Kyushu University, 6-1, Kasugakoen, Kasuga, Fukuoka 816-8580, JAPAN*

<sup>2</sup> *Gigaphoton Inc., 400 Yokokurashinden Oyama, Tochigi, 323-8558, JAPAN*

**Short-wavelength Out-of-band EUV emission from Sn Laser-produced Plasma (S43)**

*Francesco Torretti*

*EUV Plasma Processes group, Advanced Research Center for Nanolithography (ARCNL), Science Park 110, 1098XG Amsterdam*

**Vapor shielding of tin under intense plasma bombardment (S45)**

T.W. Morgan, G.G. van Eden, D.U.B. Aussems, V. Kvon, M.A. van den Berg, K. Bystrov, M.C.M. van de Sanden

*DIFFER—Dutch Institute for Fundamental Energy Research, De Zaale 20, 5612 AJ Eindhoven, The Netherlands*

**ARCNL Project Overview (Tentative Title) (S46)**

Oscar Versolato

*ARCNL*

**3:40 PM      Break and Group Photograph (20 Minutes)**

**4:00 PM      Session 5: EUV Source Modeling**

**Session Chair:**

**Towards High-Fidelity Simulations of EUV Production from Laser-Produced Plasma (S22)**

Howard Scott

*Lawrence Livermore National Laboratory, Livermore, CA, USA*

**Modeling of Particle Debris from the Target of Laser Produced Plasma EUV Sources (S24)**

Akira Sasaki

*Kansai Photon Science Institute, National Institutes for Quantum and Radiological Science and Technology, 8-1 Umemidai, Kizugawa-shi, Kyoto 619-0215, Japan*

**Atomic and Radiative Processes in High-Z Plasmas and their Applications in EUV Lithography and "Water Window" Imaging (S21)**

Bowen Li<sup>1</sup>, Takeshi Higashiguchi<sup>2</sup>, Takamitsu Otsuka<sup>2,5</sup>, Hayato Ohashi<sup>3</sup>, Chihiro Suzuki<sup>4</sup>, Emma Sokell<sup>5</sup>, Padraig Dunne<sup>5</sup>, Yang li<sup>1</sup>, Xiaokai Xu<sup>1</sup>, Ximeng Chen<sup>1</sup>, and Gerry O'Sullivan<sup>5</sup>

<sup>1</sup> *School of Nuclear Science and Technology, Lanzhou University, Lanzhou 730000, China*

<sup>2</sup> *Department of Advanced Interdisciplinary Sciences, Center for Optical Research & Education (CORE), and Optical Technology Innovation Center (OpTIC), Utsunomiya University, Yoto 7-1-2, Utsunomiya, Tochigi 321-8585 Japan*

<sup>3</sup> *Graduate School of Science and Engineering for Research, University of Toyama, Toyama, Toyama 930-8555, Japan*

<sup>4</sup> *National Institute for Fusion Science (NIFS), Toki, Gifu 509-5292, Japan*

<sup>5</sup> *School of Physics, University College Dublin, Belfield, Dublin 4, Ireland*

**Soft X-ray Spectroscopy of Dy, Er and Tm Ions Excited in Laser-Produced Plasmas (S23)**

John Sheil<sup>1</sup>, Takeshi Higashiguchi<sup>2</sup>, Domagoj Kos<sup>1</sup>, Takanori Miyazaki<sup>1,2</sup>, Fergal O'Reilly<sup>1</sup>, Gerry O'Sullivan<sup>1</sup>, Paul Sheridan<sup>1</sup>, Emma Sokell<sup>1</sup>, Chihiro Suzuki<sup>3</sup> and Deirdre Kilbane<sup>1</sup>

<sup>1</sup> *School of Physics, University College Dublin, Belfield, Dublin 4, Ireland*

<sup>2</sup> *Department of Electrical and Electronic Engineering, Faculty of Engineering and Center for Optical Research and Education (CORE), Utsunomiya University, Yoto 7-1-2, Utsunomiya, Tochigi 321-8585, Japan*

<sup>3</sup> *National Institute for Fusion Science, 322-6 Oroshi-cho, Toki 509-5292, Japan*

**5:20 PM      Break (20 Minutes)**

**5:40 PM Session 6: Poster Session**

**Session Chair:**

**Measurements and Numerical Simulations of Sn ion Stopping in Low-pressure H<sub>2</sub> Atmosphere (S25)**

D. B. Abramenko<sup>1,2</sup>, D. I. Astakhov<sup>2,3</sup>, P. V. Kraynov<sup>1,4</sup>, V. M. Krivtsun<sup>1,2</sup>, V. Medvedev<sup>1,2,3</sup>, and K. N. Koshelev<sup>1,2</sup>

<sup>1</sup> RnD-ISAN/EUV Labs, Sirenevy Bulevard Str. 1, Troitsk, Moscow 108840, Russia.

<sup>2</sup> Institute for Spectroscopy RAS, Fizicheskaya str. 5, Troitsk, Moscow 108840, Russia

<sup>3</sup> ISTEQ BV, High Tech Campus 9, Eindhoven, The Netherlands

<sup>4</sup> Moscow Institute of Physics and Technology (State University), Institutskiy pereulok str. 9, Dolgoprudny, Moscow region 141701, Russia

**Configuration Interaction Effects in Unresolved np<sup>6</sup>nd<sup>N+1</sup>-np<sup>5</sup>nd<sup>N+2</sup>+np<sup>6</sup>nd<sup>N</sup>nf<sup>1</sup> Transition Arrays; Contrasting Behaviour for n=4 and n=5" (S26)**

Luning Liu, Deirdre Kilbane, Pdraig Dunne, John Sheil, Xinbing Wang and Gerry O'Sullivan

**Modelling of hybrid pumping of nitrogen recombination laser (S34)**

P. Vrba<sup>1</sup>, M. Vrbova<sup>2</sup>

<sup>1</sup>Institute of Plasma Physics, Czech Academy of Sciences, 182 00 Prague 8, CR,

<sup>2</sup>Czech Technical University, Faculty of Biomedical Engineering, 272 01 Kladno, CR

**Expansion dynamics after laser-induced cavitation in liquid tin microdroplets (S44)**

D. Kurilovich<sup>1,2</sup>, T. Pinto<sup>1,2</sup>, R. Schupp<sup>1</sup>, F. Torretti<sup>1,2</sup>, J. Scheers<sup>1,2</sup>, A. Stodolna<sup>1,2</sup>, W. Ubachs<sup>1,2</sup>, R. Hoekstra<sup>1,3</sup>, S. Witte<sup>1</sup>, O.O. Versolato<sup>1</sup>

<sup>1</sup>Advanced Research Center for Nanolithography (ARCNL), Science Park 110, 1098 XG Amsterdam, The Netherlands

<sup>2</sup>Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands

<sup>3</sup>Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands

**Development of a collective Thomson scattering system for laser-produced high-Z plasmas for soft X-ray light sources (S47)**

Yuta Sato<sup>1</sup>, Syoichi Tsukiyama<sup>1</sup>, Raimu Fukada<sup>1</sup>, Kentaro Tomita<sup>1</sup>, Kiichiro Uchino<sup>1</sup>

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<sup>1</sup> *Interdisciplinary Graduate School of Engineering and Sciences, Kyushu University, 6-1, Kasugakoen, Kasuga, Fukuoka 816-8580, JAPAN*

### **Ion Stage Velocity Evolution in CO<sub>2</sub>-generated Laser Plasma Plumes (S48)**

Frank McQuillan

*UCD Physics, Dublin, Ireland*

### **EUV/SXR Spectroscopy of Ge Laser-Produced Plasma (S57)**

O. Maguire, D. Kos, E. Sokell

*Atomic, Molecular and Plasma (Spec) group, School of Physics, University College Dublin, Belfield Dublin 4 Ireland*

### **Colliding Laser Produced Plasmas Analysis: Fast Imaging and Spectroscopic Study (S58)**

Domagoj Kos<sup>1,2</sup>, O. Maguire<sup>1</sup>, F. O'Reilly<sup>1</sup>, P. Dunne<sup>1</sup>, E. Sokell<sup>1</sup>

<sup>1</sup>*School of Physics, University College Dublin, Belfield, Dublin 4, Ireland*

<sup>2</sup>*Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Brehova 7, 511519 Praha 1, Czech Republic*

### **High-brightness Broadband Light Source for Various Industrial Applications (S64)**

Samir Ellwi<sup>1,2</sup>

1. RnD-ISAN/EUV Labs, Troitsk, 108840 Russia

2. ISTEQ, 5656 AG Eindhoven

### **Laboratory Tomographic Microscopy with Compact Plasma based Extreme ultraviolet and Soft X-ray Sources (S74)**

Daniel Vicario<sup>1</sup>, Alexander von Wezyk<sup>2</sup>, Klaus Bergmann<sup>2</sup>, Larissa Juschkina<sup>1</sup>

<sup>1</sup>*RWTH Aachen University, Chair for Experimental Physics of EUV, JARA-FIT, Steinbachstr. 15, 52074 Aachen, Germany*

<sup>2</sup> *Fraunhofer-Institute for Laser Technology, Steinbachstr. 15, 52074 Aachen, Germany*

### **An Extreme Ultraviolet Monochromator for use with a Laser Produced Plasma Source (S86)**

Carmen Vela Garcia, Emma Sokell, Pdraig Dunne & Fergal O'Reilly

*UCD School of Physics, University College Dublin, Belfield, Dublin 4, Ireland*

**Wednesday, November 8, 2017**

**(George Moore Auditorium, UCD Campus, Dublin)**

**9:15 AM Announcements and Introductions**

**Announcements** (Intro-2)

Padraig Dunne  
UCD

**9:20 AM Session 7: Keynote Session -2**

**Session Chair:** Padraig Dunne (UCD)

**Imaging Biological Cells using Soft X-ray Tomography (S2)** (Keynote Presentation)

Carolyn Larabell  
University of California San Francisco School of Medicine and  
Lawrence Berkeley National Laboratory

**10:00 AM Session 8: EUV Metrology Sources**

**Session Chair:**

**Plasma based XUV Sources for Metrology Applications (S53)**

Klaus Bergmann, Alexander von Wezyk, Jochen Vieker  
Fraunhofer Institute for Laser Technology – ILT, Steinbachstr. 15, 52074 Aachen,  
Germany

**Characterization of Laser-assisted and laser-driven EUV sources for Metrology Applications (S51)**

Yusuke Teramoto<sup>1</sup>, Bárbara Santos<sup>1</sup>, Guido Mertens<sup>1</sup>, Margarete Kops<sup>1</sup>, Ralf Kops<sup>1</sup>,  
Alexander von Wezyk<sup>2</sup>, Klaus Bergmann<sup>2</sup>, Hironobu Yabuta<sup>3</sup>, Akihisa Nagano<sup>3</sup>,  
Takahiro Shirai<sup>3</sup>, Yoshihiko Sato<sup>3</sup>, Kunihiko Kasama<sup>3</sup>

<sup>1</sup>BLV Licht- und Vakuumtechnik GmbH, Steinbachstrasse 15, 52074 Aachen,  
Germany

<sup>2</sup>Fraunhofer ILT, Steinbachstrasse 15, 52074 Aachen, Germany

<sup>3</sup>Ushio Inc., 1-90 Komakado, Gotemba 412-0038, Japan

**Actinic Light Source based on LPP for HVM Mask Inspection Applications (S55)**

Konstantin Koshelev<sup>1,2</sup>, Alexander Vinokhodov<sup>1</sup>, Oleg Yakushev<sup>1</sup>, Alexey Yakushkin<sup>1</sup>, Dimitri Abramenko<sup>1</sup>, Alexander Lash<sup>1</sup>, Mikhail Krivokorytov<sup>1,2</sup>, Yuri Sidelnikov<sup>2</sup>, Vladimir Ivanov<sup>2</sup>, Vladimir Krivtsun<sup>2</sup>, Vyacheslav Medvedev<sup>1</sup>, Denis Glushkov<sup>3</sup>, Pavel Seroglazov<sup>3</sup>, Samir Ellwi<sup>3</sup>

1 – RnD-ISAN/EUV Labs, Troitsk, 108840 Russia;

2 – Institute for Spectroscopy RAS, Troitsk, 108840 Russia;

3 – ISTEQ, 5656 AG Eindhoven

**Laser Induced Shockwave Droplet Breakup Dynamics (S52)**

Duane Hudgins\*, Alex Nieland and Reza S. Abhari

Laboratory for Energy Conversion, Swiss Federal Institute of Technology Zurich (ETHZ), Switzerland

**A High-brightness Accelerator-based EUV source (S54) for EUV Actinic Mask Inspection**

Y. Ekinici, T. Garvey, A. Streun, A. Wrulich and L. Rivkin

Paul Scherrer Institute, Villigen, Switzerland

**Compact X-ray Sources and Applications for Semiconductor Metrology (S56)**

R. Joseph Kline

National Institute of Standards and Technology, USA

**12:00 PM      Break (15 Minutes)**

**12:15 PM      Session 9: Broad-band EUV Sources**

**Session Chairs:**

**Industry Requirements for Broad Band EUV Sources for Wafer Inspection Applications (S61)**

Vivek Bakshi

*EUV Litho, Inc.*



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### **High Power Laser-Sustained Plasma Light Sources for KLA-Tencor Broadband Wafer Inspection Tools (S63)**

I. Bezel, M. Derstine, K. Gross, A. Shchemelinin, J. Szilagy, and D. Shortt  
*Technology Group, WIN Division, KLA-Tencor Corp, One Technology Drive, Milpitas, CA 95035*

### **The Electrode-less Z-Pinch as a Metrology Source in the 40-50 nm range (S62)**

Stephen F. Horne, Matthew M. Besen, Paul A. Blackborow, Deborah Gustafson, Matthew J. Partlow, Donald K. Smith  
*Energetiq Technology Inc., 7 Constitution Way, Woburn MA 01801*

**1:00 Lunch (90 Minutes)**

## **2:30 PM Session 10: EUV and XUV Applications**

### **Session Chairs:**

#### **Soft X-ray Microscopes for Biology: The Source (S71)**

Gerry McDermott, Ph.D.  
*Department of Anatomy, UCSF and Lawrence Berkeley National Laboratory*

#### **Chromatin Reorganization during Viral Infection (S72)**

Vesa Aho<sup>1</sup>, Markko Myllys<sup>1</sup>, Carolyn A. Larabell<sup>2,3</sup> and Maija Vihinen-Ranta<sup>4</sup>  
*1. Department of Physics and Nanoscience Center, University of Jyväskylä, Jyväskylä, Finland*

*2. Department of Anatomy, University of California San Francisco, San Francisco, California, USA*

*3. Physical Biosciences Division, Lawrence Berkeley National Laboratory, Berkeley, California, USA*

*4. Department of Biological and Environmental Science, University of Jyväskylä, Jyväskylä, Finland*

#### **Exploring the Soft X-ray Radiance of Laser Plasmas (S73)**

Fergal O'Reilly and Gladson Joseph  
*UCD School of Physics, University College Dublin, Belfield, Dublin 4, Ireland.*

### **Relativistic Plasma Control using Two-colour Fields (S75)**

Brendan Dromey\*<sup>1</sup>, Mark Yeung<sup>1</sup>, Sergey Rykovanov<sup>2</sup>, Jana Bierbach<sup>2,3</sup>, Lu Li<sup>1</sup>, E. Eckner<sup>3</sup>, Stephan Kuschel<sup>2,3</sup>, Abel Woldegeorgis<sup>2,3</sup>, Christian Rödel<sup>2,3,4</sup>, Alexander Sävert<sup>3</sup>, Gerhard G. Paulus<sup>2,3</sup>, Mark Coughlan<sup>1</sup>, and Matthew Zepf<sup>1,2,3</sup>

<sup>1</sup> Department of Physics and Astronomy, Queen's University Belfast, Belfast, UK

<sup>2</sup> Helmholtz Institute Jena, Fröbelstieg 3, Jena, Germany

<sup>3</sup> Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, Jena, Germany

<sup>4</sup> SLAC National Accelerator Laboratory, 2575 Sand Hill Road, Menlo Park, California, USA

### **Spectroscopic EUV reflectometry for characterization of thin films systems and determination of optical constants (S76)**

Larissa Juschkin<sup>1,2\*</sup>, Maksym Tryus<sup>1</sup>, Konstantin Nikolaev<sup>3</sup>, Igor Makhotkin<sup>3</sup>, Daniel Wilson<sup>2</sup>, Lidia Kibkalo<sup>2</sup>, Jürgen Schubert<sup>2</sup>, Angelo Giglia<sup>4</sup>, Piergiorgio Nicolosi<sup>5</sup>, and Serhiy Danylyuk<sup>6</sup>

<sup>1</sup> RWTH Aachen University, Chair for Experimental Physics of EUV, JARA-FIT, Germany

<sup>2</sup> Forschungszentrum Jülich GmbH, Peter Grünberg Institut 9, JARA-FIT, Germany

<sup>3</sup> University of Twente, Faculty of Science and Technology, Enschede, The Netherlands

<sup>4</sup> CNR - Istituto Officina Materiali, Trieste, Italy

<sup>5</sup> Università degli Studi di Padova, Dipartimento di Ingegneria dell'Informazione, Italy

<sup>6</sup> RWTH Aachen University, Chair for Technology of Optical Systems, JARA-FIT, Germany

**4:10 PM      Break (20 Minutes)**

**4:30 PM      Session 11: Optics and Metrology**

**Session Chairs:**

### **REFURBISHMENT OF COLLECTOR MIRRORS FOR WATER WINDOW MICROSCOPY (S81)**

T. Feigl, H. Pauer, M. Perske, T. Fiedler, P. Naujok  
*optiX fab GmbH, Hans-Knöll-Str. 6, 07745 Jena, Germany*

*F. Scholze, C. Laubis*

*Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin, Germany*

## 2017 Source Workshop

### **EUVL Optics for Free Electron Laser Sources: Damage Threshold Studies and the Use of Adjusted Wavelengths (S82)**

Eric Louis

*MESA+ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE, Enschede, The Netherlands*

### **Novel Spectrometers for Broad-band Characterization of EUV-Emitting Plasmas (S83)**

V V Medvedev

*RnD-ISAN, Promyshlennaya 1A, Troitsk, Moscow, Russia*

*EUV Labs, Sirenevy bulevard 1, Troitsk, Moscow, Russia*

*ISTEQ BV, High Tech Campus 9, Eindhoven, The Netherlands*

### **Broadband Spectral Characterization of EUV light Sources with a Transmission Grating Spectrometer (S85)**

Muharrem Bayraktar<sup>1\*</sup>, Fei Liu<sup>2</sup>, Bert Bastiaens<sup>3</sup>, Caspar Bruineman<sup>4</sup> and Fred Bijkerk<sup>1</sup>

<sup>1</sup> *Industrial Focus Group XUV Optics, MESA + Institute for Nanotechnology, University of Twente, The Netherlands*

<sup>2</sup> *ASML Netherlands B.V., De Run 6501, 5504 DR Veldhoven, The Netherlands*

<sup>3</sup> *Laser Physics and Nonlinear Optics, MESA + Institute for Nanotechnology, University of Twente, The Netherlands*

<sup>4</sup> *Scientec Engineering, The Netherlands*

## **5:50 PM Announcements**

Vivek Bakshi

*EUV Litho, Inc.*

## **Workshop Adjourned and Depart for off-site Dinner**

