

# 2012 International Workshop on EUV and Soft X-Ray Sources

October 8-11, 2012

Dublin ■ Ireland

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## Workshop Proceedings



# Workshop Proceedings

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# **Agenda Outline**

## **Monday, October 8, 2012**

**Location: Newman House, Stephen's Green, Dublin**

6:00 - 7:00 PM                      Reception and Speaker Prep

## **Tuesday, October 9, 2012**

**Location: Clinton Auditorium,  
UCD Campus, Dublin**

7:45 AM	Pickup at the Hotel (Stephen's Green and Burlington Hotel)
8:30 AM – 11:30 AM	Workshop Presentations
11:40 AM -12:40 PM	Lunch
12:40 PM – 5:30 PM	Workshop Presentations
5:30 PM – 6:30 PM	Poster Session and Reception
6:30 PM	Depart for Off-Site Dinner (Pickup at Clinton Auditorium)

## **Wednesday, October 10, 2012**

**Location: Clinton Auditorium  
UCD Campus, Dublin**

7:45 AM	Pickup at the Hotel (Stephen's Green and Burlington)
8:30 AM – 1:00 PM	Workshop Presentations
1:00 PM - 2:00 PM	Lunch
2:00 PM	Depart for tour of Trim Castle (Pickup at Clinton Auditorium)

## **Thursday, October 11, 2012**

**Location: Newman House, Stephen's Green, Dublin**

### **Technical Working Group (TWG) Meeting**

8:30 AM	Continental Breakfast
9:00 AM – 10:00 AM	TWG Meeting



# WORKSHOP PROCEEDINGS

## 2012 International Workshop on EUV and Soft X-Ray Sources

October 8-11, 2012, Dublin, Ireland

### Monday, October 8, 2012 (Newman House)

6:00 PM – 7:00 PM Reception and Registration

### Tuesday, October 9, 2012 (Clinton Auditorium)

#### 8:30 AM Session 1 : Welcome and Announcements

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

Vivek Bakshi, EUV Litho, Inc., USA  
Des Fitzgerald, VP, UCD

#### 8:40 AM Session 2: Keynote-1

Session Chair: Vadim Banine (ASML)

##### High Repetition Rate Table-top Soft X-Ray Lasers (S1)

J. J. Rocca<sup>1,2,3</sup>, B. Reagan<sup>1,2</sup>, Y. Wang<sup>1,2</sup>, D. Alessi, B. M. Luther<sup>1,2</sup>,  
K. Wernsing<sup>1,2</sup>, L. Yin<sup>1,2</sup>, M. A. Curtis<sup>1,2</sup>, M. Berrill<sup>1,2</sup>, D. Martz<sup>1,2</sup>,  
V.N. Shlyaptsev<sup>1,2</sup>, S. Wang<sup>1,2</sup>, F. Furch<sup>1,3</sup>, M. Woolston<sup>1,2</sup>, D. Patel<sup>1,2</sup>,  
C.S. Menoni<sup>1,2</sup>

<sup>1</sup> National Science Foundation ERC for Extreme Ultraviolet Science and Technology

<sup>2</sup> Electrical and Computer Engineering Department, Colorado State University, Fort Collins, CO 80523

<sup>3</sup> Physics Department, Colorado State University, Fort Collins, CO 80523

##### Extendibility of LPP EUV Source Technology in Higher Power (kW) and Shorter Wavelength (6.x nm) Operation (S2)

Akira Endo

Waseda University, Tokyo, Japan

HiLASE Project, Prague, Czech Republic



## Awards and Announcements – Padraig Dunne (UCD)

### Break 10:00 AM

### 10:20 AM Session 3: HVM EUV Sources

*Session Chair: Katsuhiko Murakami (NIKON)*

#### [EUV Lithography: Today and Tomorrow? \(S10\)](#) (Invited Paper)

Vadim Banine

ASML, The Netherlands

#### [EUVL - A Reality in the Making](#)

#### [The Reality of Laser Assisted Discharge Plasma EUV Light Sources \(S49\)](#)

(Invited Paper)

Jeroen Jonkers

XTREME technologies, GmbH, Steinbachstrasse 15, 52074 Aachen, Germany

#### [New type of DPP source with liquid tin jets electrode - recent progress \(S61\)](#)

V.Krivtsun \*, O.Yakushev \*, A.Vinohodov\*, \*\*, V.Borisov\*\* , V.Ivanov\* and K.Koshelev\*

\* RnD-ISAN / EUVLabs, \*\* TRINITI

#### [High Brightness, High-average Power Picosecond Thin Disc Laser Program to Specific Requirements from Short Wavelength Light Sources \(S28\)](#)

Taisuke Miura, Michal Chyla, Martin Smrž, Patricie Severová, Ondřej Novák, Akira Endo, and Tomáš Mocek

*HiLASE Project, Institute of Physics AS, CR, Na Slovance 2, 182 21 Prague 8, Czech Republic*

### Lunch 11:40 AM

### 12:40 PM Session 4: EUV Sources for Mask Metrology

*Session Co-Chairs: Klaus Bergman (ILT-Fraunhofer) and Larissa Juschkin (RWTH – Aachen)*

#### [EUV Source For Metrology of EUV Masks \(Tentative title\) \(S51\)](#) (Invited Paper)

Heiko Feldmann, Ulrich Müller

Carl Zeiss, 73447 Oberkochen, Germany



**Discharge based EUV Source for Metrology (S58)** (Invited Paper)

Klaus Bergmann

*Fraunhofer Institute for Laser Technology, Steinbachstr. Aachen, Germany*

**Electrodeless Z-Pinch™ EUV Source for Next Generation EUV Metrology (S36)** (Invited Paper)

Deborah Gustafson, Stephen F. Horne, Matthew M. Besen, Donald K. Smith, Matthew J. Partlow, Paul A. Blackborow

*Energetiq Technology, Inc., 7 Constitution Way, Woburn, MA, USA 01801*

**Recent Progress on High Brightness Source Collector Module for EUV Mask Metrology (S31)**

Paul Sheridan<sup>1</sup>, Kenneth Fahy<sup>1</sup>, Padraig Dunne<sup>2</sup>, and Fergal O'Reilly<sup>2</sup>

<sup>1</sup>*NewLambda Technologies Ltd, Science Center North, Belfield, Dublin 4, Ireland*

<sup>2</sup>*UCD School of Physics, UCD, Stillorgan Rd, Dublin 4, Ireland*

**Source Brightness Requirements for EUV Microscopes (S39)**

(Invited Paper)

Larissa Juschkin<sup>1</sup>, Fergal O'Reilly<sup>2</sup>

<sup>1</sup>*RWTH Aachen University, Experimental Physics of EUV, Steinbachstr. 15, 52074 Aachen, Germany*

*and JARA - Fundamentals of Future Information Technology (FIT), 52425 Jülich, Germany*

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

**Break 2:00 PM (20 Minutes)**

**2:20 PM Session 5: Modeling**

*Session Co-Chairs: Gerry O'Sullivan (UCD) and Sergey Sergey V. Zakharov (EPPRA)*

**Modeling and Optimization of Pre-conditioned LPP targets (S52)** (Invited Paper)

K. N. Koshelev<sup>1,2</sup>, V. V. Ivanov<sup>1,2</sup>, V. G. Novikov<sup>1,3</sup>, V. M. Krivtsun<sup>1,2</sup>, A. S. Grushin<sup>1,3</sup>, V. Medvedev<sup>4</sup>

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<sup>3</sup>*Keldysh Institute of Applied Mathematics RAS, Moscow, 125047 Russia*

<sup>4</sup>*Dutch Institute for Fundamental Energy Research, Nieuwegein, The Netherlands*





## **Unresolved Transition Arrays and their role in EUV and Soft X-ray Source Development (S56)**

Gerry O'Sullivan<sup>1</sup>, John Costello<sup>2</sup>, Thomas Cummins<sup>1</sup>, Rebekah D'Arcy<sup>1</sup>, Padraig Dunne<sup>1</sup>, Akira Endo<sup>3</sup>, Paddy Hayden<sup>2</sup>, Takeshi Higashiguchi<sup>4</sup>, Imam Kambali<sup>1</sup>, Deirdre Kilbane<sup>1</sup>, Bowen Li<sup>1</sup>, Colm O'Gorman<sup>1</sup>, Takamitsu Otsuka<sup>4</sup>, Emma Sokell<sup>1</sup> and Noboru Yugami<sup>4</sup>

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

<sup>2</sup>*School of Physics, Dublin City University, Glasnevin, Dublin 9*

<sup>3</sup>*HiLASE Project, Institute of Physics AS, CR, Na Slovance 2, 18221 Prague 8, Czech Republic*

<sup>4</sup>*Department of Advanced Interdisciplinary Sciences, Utsunomiya University, Yoto 7-1-2, Utsunomiya, Tochigi 321-8585 Japan.*

## **Properties of High-intensity EUV & Soft-X Radiation Plasma Sources (S25)**

(Invited Paper)

Vasily S. Zakharov<sup>1,2</sup>, Sergey V. Zakharov<sup>1,2,3</sup>, Peter Choi<sup>1</sup>

<sup>1</sup>*EPPRA sas, Villebon sur Yvette, France in collaboration with KIAM RAS, Moscow, Russia* <sup>2</sup>*NRC Kurchatov Institute, Moscow, Russia*

<sup>3</sup>*JIHT RAS and SRC RF TRINITI, Moscow, Russia*

## **4:00 PM Session 6: EUV/ BEUV/ XUV Optics**

*Session Co-Chairs: Eric Louis (DIFFER) and Yuriy Platonov (RIT)*

### **Multilayers for 6.8 nm Wavelength (S50)** (Invited Paper)

I.A. Makhotkin<sup>1</sup>, E. Louis<sup>1</sup>, E. Zoethout<sup>1</sup>, R.W.E. van de Kruijs<sup>1</sup>, Andrei M. Yakunin<sup>2</sup>, Stephan Müllender<sup>3</sup> and F. Bijkerk<sup>1,4</sup>

<sup>1</sup> *FOM Institute DIFFER - Dutch Institute for Fundamental Energy Research, Nieuwegein, the Netherlands*

<sup>2</sup> *ASML, Veldhoven, the Netherlands*

<sup>3</sup> *Carl Zeiss SMT GmbH, Oberkochen, Germany*

<sup>4</sup> *MESA+ Institute for Nanotechnology, University of Twente, Enschede, the Netherlands*

### **New High Reflective Multilayer Designs for the EUV and Soft X-ray Range (S57)** (Invited paper)

Marco Perske, Hagen Pauer, Tobias Fiedler, Sergiy Yulin, Viatcheslav Nesterenko, Mark Schürmann, Torsten Feigl, Norbert Kaiser

*Fraunhofer-Institut für Angewandte Optik und Feinmechanik, Albert-Einstein-Str. 7, 07745 Jena, Germany*

### **Optics for EUV/XUV/XR Sources and Laboratory Submicron Microscopy**

**(S55)** (Invited Paper)

Ladislav Pina<sup>1</sup>, Veronika Pickova<sup>1</sup>, Radka Havlikova<sup>1</sup>, Hana Zakova<sup>2</sup>, Alexandr Jancarek<sup>1</sup>, Adolf Inneman<sup>3</sup>, Martin Horvath<sup>3</sup>, Jiri Marsik<sup>3</sup>, Peter Oberta<sup>3</sup>, Henryk Fiedorowicz<sup>4</sup>, Andrzej Bartnik<sup>4</sup>

<sup>1</sup>*Czech Technical University in Prague, Faculty of Nuclear Sciences and Phys. Engineering, 115 19 Prague 1, Czech Republic*

<sup>2</sup>*Czech Technical University in Prague, Faculty of Biomedical Engineering, 272 01 Kladno, Czech Republic*

<sup>3</sup>*Rigaku Innovative Technologies Europe, 142 21 Prague 4, Czech Republic*

<sup>4</sup>*Military University of Technology, Institute of Optoelectronics, 00-908 Warszawa 49, Poland*

### **Corrosion-resistant, Triple-wavelength Mg/SiC Multilayer Coatings for the 25-80 nm Wavelength Region** (S45) (Invited Paper)

Regina Soufli<sup>1</sup>, Mónica Fernández-Perea<sup>1</sup>, Jeff C. Robinson<sup>1</sup>, Sherry L. Baker<sup>1</sup>, Jennifer Alameda<sup>1</sup>, Christopher C. Walton<sup>1</sup>, Luis Rodríguez-De Marcos<sup>2</sup>, Jose A. Méndez<sup>2</sup>, Juan I. Larruquert<sup>2</sup>, Eric M. Gullikson<sup>3</sup>

<sup>1</sup>*Lawrence Livermore National Laboratory, Livermore, California, US*

<sup>2</sup>*Instituto de Óptica, Consejo Superior de Investigaciones Científicas, Madrid, Spain*

<sup>3</sup>*Lawrence Berkeley National Laboratory, Berkeley, California, US*

### **Nanoscale Multilayer Membranes as Optical Elements for EUVL** (S59)

Nikolay Chkhalo<sup>1</sup>, Mikhail Drozdov<sup>1</sup>, Evgeny Klunokov<sup>1</sup>, Aleksei Lopatin<sup>1</sup>, Valerii Luchin<sup>1</sup>, Nikolay Salashchenko<sup>1</sup>, Nikolay Tsybin<sup>1</sup>, Leonid Sijmaenok<sup>2</sup>, Vadim Banine<sup>3</sup>, Luigi Scaccabarozzi<sup>3</sup>, Andrei Yakunin<sup>3</sup>

<sup>1</sup>*Institute for Physics of Microstructures RAS, Ulyanova 46, 603155 Nizhniy, Novgorod, Russia*

<sup>2</sup>*PhysTeX, Jos Francotteweg 6b, 6291 GP Vaals, Netherlands*

<sup>3</sup>*ASML Netherlands, De Run 6501, 5504 DR Veldhoven, Netherlands*

**5:30 PM – 6:30 PM      Session 7: Poster Session**

**7:00 PM      Depart for Off-site Dinner  
(Royal Dublin Society)**

**End of Day 2**

## 5:30 PM Session 7: Poster Session

### Topic: HVM Sources

#### [Next Generation of EUV Lithography: Challenges and Opportunities \(S47\)](#)

Andrei M. Yakunin, Vadim Banine  
ASML, Veldhoven, The Netherlands

#### [Direct Diagnostics Concept for High Power CO<sub>2</sub> Laser at the LPP Focus Spot \(S20\)](#)

Kazuyuki Sakaue, Yasufumi Yoshida, Ryo Sato, Masakazu Washio, Akira Endo  
Research Institute for Science and Engineering, Waseda university, 3-4-1 Okubo,  
Shinjuku, Tokyo 169-855 Japan

#### [Research of the CO<sub>2</sub> Laser MOPA System \(S44\)](#)

Wang Xinbing<sup>1\*</sup>, Zuo DuLuo<sup>1</sup>, Lu Peixiang<sup>2</sup>

<sup>1</sup>Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan 430074, China

<sup>2</sup> School of Physics, Huazhong University of Science and Technology, Wuhan 430074, China

#### [2D PIC Modeling of the EUV Induced Hydrogen Plasma and Comparison to the Observed Carbon Etching Rate \(S27\)](#)

D.I. Astakhov<sup>1,3\*</sup>, W.J. Goedheer<sup>1</sup>, D.V. Lopaev<sup>2</sup>, V.V. Ivanov<sup>3</sup>, V.M. Krivtsun<sup>3</sup>,  
O. Yakushev<sup>3</sup>, K.N. Koshelev<sup>3</sup>, and F. Bijkerk<sup>1,4</sup>

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<sup>2</sup>Institute of Nuclear Physics, Moscow State University, Russia

<sup>3</sup>Institute for Spectroscopy, Russian Academy of Sciences, Troitsk, Russia

<sup>4</sup>MESA+ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands

### Topic: EUV Sources for Mask Metrology

#### [Feasibility Study of Microplasma High-brightness EUV Source at 13.5 nm \(S13\)](#)

Takeshi Higashiguchi<sup>1</sup>, Yoichi Hirose<sup>1</sup>, Yuhei Suzuki<sup>1</sup>, Takamitsu Otsuka<sup>1</sup>, Jun-ichiro Sugisaka<sup>1</sup>, Akira Endo<sup>2</sup>, Padraig Dunne<sup>3</sup>, and Gerry O'Sullivan<sup>3</sup>

<sup>1</sup>Department of Advanced Interdisciplinary Sciences, Center for Optical Research & Education (CORE), and Optical Technology Innovation Center (OpTIC),  
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<sup>3</sup>School of Physics, University College Dublin, Belfield, Dublin 4, Ireland

### **Diagnosics and Modeling of Gas Puff Target Laser Plasma Radiation Source (S18)**

Sarka Vondrova<sup>1</sup>, Dalibor Panek<sup>1</sup>, Petr Bruza<sup>1</sup>, Miroslava Vrbova<sup>1</sup>, Pavel Vrba<sup>2</sup>, Przemyslaw Wachulak<sup>3</sup>, Frantisek Krejci<sup>1, 4</sup>, Jan Jakubek<sup>4</sup>

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<sup>2</sup>Institute of Plasma Physics, Academy of Sciences, 182 00 Prague 8, Czech Republic

<sup>3</sup>Military University of Technology, Institute of Optoelectronics, 00-908 Warszawa 49, Poland

<sup>4</sup>Czech Technical University in Prague, Institute of Experimental and Applied Physics, 128 00 Prague 2, Czech Republic

### **In-situ Diagnostics for Plasma based Extreme Ultraviolet Sources (S22)**

T. W. Versloot, F.T. Molkenboer, H.H.P.Th. Bekman, N.B. Koster, E. te Sligte, R. Verberk, R.C.M. Pohlmann, F.H. Elferink  
TNO Delft, Stieltjesweg 1, 2628 CK, Delft, the Netherlands

### **Laser-initiated Discharge-produced Plasma Ablated from Liquid Metal Electrodes (S26)**

Vasily S. Zakharov<sup>1\*</sup>, Larissa Juschkina<sup>2</sup>, Sergey V. Zakharov<sup>1\*+</sup>, Gerry O'Sullivan<sup>3</sup>, Emma Sokel<sup>3</sup>, Isaac Tobin<sup>4</sup>

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<sup>3</sup>University College Dublin, Ireland

<sup>4</sup>Trinity College Dublin, Ireland

\* also with NRC Kurchatov Institute, Moscow, Russia

+ also with JIHT RAS and SRC RF TRINITI, Moscow, Russia

### **EUV Emission from Laser-triggered Z-pinch Discharge (S30)**

Isaac Tobin<sup>1</sup>, Larissa Juschkina<sup>2,3</sup>, Fergal O'Reilly<sup>2</sup>, Paul Sheridan<sup>4</sup>, Emma Sokel<sup>2</sup>, James G. Lunney<sup>1</sup>

<sup>1</sup>School of Physics, Trinity College Dublin, Dublin 2, Ireland.

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<sup>3</sup>Department of Physics, RWTH Aachen University, Steinbachstr. 15 D-52074 Aachen, Germany.

<sup>4</sup>NewLambda Technologies, UCD Science Centre North, Belfield, Dublin 4, Ireland.

### **ST-100: Clean Bright Focused Photons (S63)**

Paul Sheridan<sup>1</sup>, Kenneth Fahy<sup>1</sup>, Pdraig Dunne<sup>2</sup>, and Fergal O'Reilly<sup>2</sup>

<sup>1</sup>NewLambda Technologies Ltd, Science Center North, Belfield, Dublin 4, Ireland

<sup>2</sup>UCD School of Physics, UCD, Stillorgan Rd, Dublin 4, Ireland



## **Topic: Applications of EUV Sources**

### **R&D Actinic Blank Inspection Microscope (S40)**

Larissa Juschkin<sup>1</sup>, Stefan Herbert<sup>2</sup>, Aleksey Maryasov<sup>2</sup>, Serhiy Danylyuk<sup>2</sup>, Rainer Lebert<sup>3</sup>

<sup>1</sup>RWTH Aachen University, Experimental Physics of EUV, Steinbachstr. 15, 52074 Aachen, Germany

<sup>2</sup>RWTH Aachen University, Chair for Technology of Optical Systems, 52074 Aachen, Germany

<sup>3</sup>Bruker Advanced Supercon GmbH, Waltherstrasse 49-51, 51069 Köln, German

### **Exploring the Resolution Limit of the Talbot lithography with EUV Light (S41)**

Hyun-su Kim<sup>1</sup>, Serhiy Danylyuk<sup>2</sup>, Sascha Brose<sup>2</sup>, Klaus Bergmann<sup>3</sup>, Detlev Grützmacher<sup>4</sup>, Larissa Juschkin<sup>1</sup>

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<sup>3</sup>Fraunhofer Institute for Laser Technology, Steinbachstr. 15, Aachen, Germany

<sup>4</sup>Peter Grünberg Institute 9 (PGI-9): Semiconductor Nanoelectronics, Research Center Jülich

and JARA - Fundamentals of Future Information Technology (FIT), 52425 Jülich, Germany

### **EUV Interference Lithography with Partially Coherent Laboratory Sources (S64)**

Larissa Juschkin<sup>1</sup>, SerhiyDanylyuk<sup>2</sup>, Sascha Brose<sup>2</sup>, Hyun-suKim<sup>1</sup>, Jürgen Moers<sup>3</sup>, Klaus Bergmann<sup>4</sup>, Peter Loosen<sup>2,4</sup>, Detlev Grützmacher<sup>3</sup>

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## Topic: Modeling

### Modeling of Absorption and Scattering of IR laser Radiation by LPP Targets (S53)

A. S. Grushin<sup>1,2</sup>, I. P. Tsygvintsev<sup>1,2</sup>, V. G. Novikov<sup>1,2</sup>, V. V. Ivanov<sup>1,3</sup>

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<sup>2</sup>Keldysh Institute of Applied Mathematics RAS, Moscow, 125047 Russia

<sup>3</sup>Institute for Spectroscopy RAS, Troitsk, 142090 Russia

### Modeling of Plasma Dynamics and EUV Generation for Distributed Sn Targets Irradiated with Short Laser Pulses (S54)

V. Ivanov<sup>1</sup>, A. Grushin<sup>2</sup>, V. Novikov<sup>2</sup>, V. Medvedev<sup>3</sup>, V. Krivtsun<sup>1</sup>, A. Yakunin<sup>4</sup>, and K. Koshelev<sup>1</sup>

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<sup>3</sup>Dutch Institute for Fundamental Energy Research, Nieuwegein, The Netherlands

<sup>4</sup>ASML, The Netherlands

## Topic: BEUV

### Alternative Future 6.x nm EUV Sources from Strong In-band Line Emission (S29)

Thomas Cummins<sup>1</sup>, Takamitsu Otsuka<sup>2</sup>, Tony Donnelly<sup>1</sup>, Weihua Jiang<sup>3</sup>, Akira Endo<sup>4</sup>, Padraig Dunne<sup>1</sup>, Gerry O'Sullivan<sup>1</sup> and Takeshi Higashiguchi<sup>2</sup>

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

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<sup>4</sup>HiLASE Project, Institute of Physics AS, CR, Na Slovance 2, 182 21 Prague 8, Czech Republic

### A Tunable Beyond Extreme Ultraviolet Source at 6.x nm based on a Laser-produced Plasma from a High-Z Target Mix (S32)

Colm O'Gorman<sup>1</sup>, Takamitsu Otsuka<sup>2</sup>, Weihua Jiang<sup>3</sup>, Akira Endo<sup>4</sup>, Bowen Li<sup>1</sup>, Thomas Cummins<sup>1</sup>, Padraig Dunne<sup>1</sup>, Emma Sokell<sup>1</sup>, Gerry O'Sullivan<sup>1</sup>, and Takeshi Higashiguchi<sup>2</sup>

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

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<sup>3</sup>Department of Electrical Engineering, Nagaoka University of Technology, Kami-tomiokamachi 1603-1, Nagaoka, Niigata 940-2188 Japan

<sup>4</sup>HiLASE Project, Institute of Physics AS, CR, Na Slovance 2, 182 21 Prague 8, Czech Republic



## **Identification of Atomic Resonances for Enhancement of High Harmonic Generation in Laser-produced Plasmas (S35)**

R. Stefanuik<sup>a</sup>, N. Krstulovic<sup>a</sup>, M. Mahmood<sup>b</sup>, P. Dunne<sup>a</sup>, G. O'Sullivan<sup>a</sup>

*a: School of Physic, University college Dublin, Ireland*

*b: Institute Of Lasers for postgraduate studies, University of Baghdad, Iraq*

## **EUV Spectra of Highly Charged Heavy Ions in the NIST EBIT (S60)**

D. Kilbane<sup>a</sup>, J. D. Gillaspay<sup>b</sup>, Yu. Ralchenko<sup>b</sup>, J. Reader<sup>b</sup>, G. O'Sullivan<sup>a</sup>

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*<sup>b</sup> National Institute of Standards and Technology, Gaithersburg, MD 20899, USA*

## **Topic: XUV**

### **Possibility of High-Z Plasma Water Window Sources (S14)**

Takeshi Higashiguchi<sup>1</sup>, Takamitsu Otsuka<sup>1</sup>, Weihua Jiang<sup>2</sup>, Akira Endo<sup>3</sup>,  
Bowen Li<sup>4</sup>, Deirdre Kilbane<sup>4</sup>, Pdraig Dunne<sup>4</sup>, and Gerry O'Sullivan<sup>4</sup>

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

### **A Capillary Discharge-preformed Argon Plasma Waveguide for a Coherent Soft X-ray Source (S15)**

Shohei Sakai<sup>1</sup>, Takeshi Higashiguchi<sup>1</sup>, Nadezhda Bobrova<sup>2</sup>, Pavel Sasorov<sup>2</sup>, and Noboru Yugami<sup>1</sup>

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*<sup>2</sup>Institute for Theoretical and Experimental Physics, B. Cheremushkinskaya str. 25, 117218 Moscow, Russia*

### **Measurement of Spectra in Water- window Wavelength Region (S23)**

J. Novak<sup>1</sup>, M. Nevrkla<sup>1</sup>, A. Jancarek<sup>1</sup>, M. Vrbova<sup>2</sup>, P. Vrba<sup>3</sup>

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

*<sup>3</sup>Institute of Plasma Physics, Academy of Sciences, 182 00 Prague 8, Czech Republic*



### **Characterization of Capillary Discharge Water-Window Radiation Source (S24)**

Michal Nevrkla<sup>1</sup>, Jan Novak<sup>1</sup>, Alexandr Jancarek<sup>1</sup>, Pavel Vrba<sup>2</sup>, Miroslava Vrbova<sup>3</sup>

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<sup>3</sup> Czech Technical University in Prague, Faculty of Biomedical Engineering, 272 01 Kladno, Czech Republic

### **Emission Properties of Non-equilibrium Zirconium Plasma in Soft X-ray Region (S33)**

Vasily S. Zakharov\*, Sergey V. Zakharov \*+

EPPRA sas, Villebon sur Yvette, France

in collaboration with KIAM RAS, Moscow, Russia

\* also with NRC Kurchatov Institute, Moscow, Russia

+ also with JIHT RAS and SRC RF TRINITI, Moscow, Russia

### **A Commercial Laboratory Soft-X-ray Source for Water Window Microscopy (S37)**

Stephen F. Horne, Matthew M. Besen, Donald. K Smith

Energetiq Technology, Inc., 7 Constitution Way, Woburn, MA, USA 01801

### **Spectral Characterization of XUV Sources based on Plasmas Induced by Laser and Capillary Discharge (S38)**

P. Kolar<sup>1</sup>, D. Panek<sup>1</sup>, M. Vrbova<sup>1</sup>, M. Nevrkla<sup>2</sup>, P. Vrba<sup>3</sup>, and A. Jancarek<sup>2</sup>

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<sup>2</sup> Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Trojanova 13, 120 00 Praha 2, Czech Republic

<sup>3</sup> Institute of Plasma Physics, The Academy of Sciences of the Czech Republic, Za Slovankou 1782/3, 182 00 Prague, Czech Republic

### **XUV Spectroscopy of the Interaction of Laser-produced Plasma with Solid Surfaces (S42)**

A S Kuznetsov<sup>1</sup>, R Stuik<sup>2</sup>, F Bijkerk<sup>1,3</sup>, Eric Louis and A P Shevelko<sup>4</sup>.

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<sup>2</sup> Leiden Observatory, Universiteit Leiden, Postbus 9513, 2300 RA Leiden, The Netherlands

<sup>3</sup> MESA+ Institute for Nanotechnology, University of Twente, Postbus 217, 7500 AE Enschede, The Netherlands

<sup>4</sup> P.N. Lebedev Physical Institute of the Russian Academy of Sciences, 117924 Moscow, Russia



## Wednesday, October 10, 2012

### 8:30 AM Announcements

#### [Introduction and Announcements](#) (Intro-2)

*Vivek Bakshi, EUV Litho, Inc.*

#### Poster Session Awards and Announcements

*Padraig Dunne (UCD)*

### 8:40 AM Session 9: Keynote-2

*Session Chair: Padraig Dunne (UCD)*

#### [Microfocus Sources for EUV and X-ray Applications](#) (S3)

Alan Michette

*Department of Physics, King's College London, Strand, London WC2R 2LS, UK*

### 9:35 AM Session 10: Business Presentations

*Session Chair: Padraig Dunne (UCD)*

#### [Erasmus Mundus Joint Doctorate Programme EXTATIC \(EUV and X-Ray Training in Advanced Technologies for Interdisciplinary Cooperation\) - Program Review](#) (S48)

Paul van Kampen

*School of Physical Sciences, Dublin City University, Dublin, Ireland*

### 10:05 AM Break (20 Minutes)



## 10:20 AM Session 11: BEUV

Session Co-Chairs: Udo Dinger (Carl Zeiss) and Takeshi Higashiguchi (Utsunomiya University)

### **Plasma-based UTA Emission in BEUV & Water Window Spectral Regions**

**(S11)** (Invited Paper)

Takeshi Higashiguchi<sup>1</sup>, Takamitsu Otsuka<sup>1</sup>, Weihua Jiang<sup>2</sup>, Akira Endo<sup>3</sup>, Thomas Cummins<sup>4</sup>, Colm O’Gorman<sup>4</sup>, Bowen Li<sup>4</sup>, Deirdre Kilbane<sup>4</sup>, Padraig Dunne<sup>4</sup>, and Gerry O’Sullivan<sup>4</sup>

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<sup>3</sup>HiLASE Project, Institute of Physics AS, CR, Na Slovance 2, 18221 Prague 8, Czech Republic

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

### **Dual Laser Plasma Photoabsorption Studies Of Gadolinium In The Extreme Ultraviolet Region** (S34) (Invited Paper)

Paddy Hayden, C. Fallon, T. J. Kelly and J. T. Costello

School of Physical Sciences/National Centre for Plasma Science and Technology, Dublin City University, Glasnevin, Dublin 9, Ireland

### **Highlights from a Recent BEUV Source Workshop (September 26, 2012, Japan)** (S12)

Takeshi Higashiguchi  
Utsunomiya University

### **Concept Study on an Accelerator based Source for 6.x nm Lithography** (S16)

Udo Dinger<sup>1</sup>, Diana Tuerke<sup>1</sup>, Atoosa Meseck<sup>2</sup>, Michael Patra<sup>1</sup>, Erik Sohmen<sup>1</sup>, Andreas Jankowiak<sup>2</sup>

<sup>1</sup> Carl Zeiss SMT GmbH, Rudolf - Eber - Straße 2, 73447 Oberkochen

<sup>2</sup> Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Hahn-Meitner-Platz 1, 14109 Berlin

## **Session 12: XUV and Applications**

*Session Co-Chairs: Ladislav Pina (RIT-Europe) and Rainer Lebert (Bruker)*

### **High-brightness Liquid-jet Laser-plasma Enabling 10-second-exposure Water-window Cryo Microscopy (S43)** (Invited Paper)

*M. Selin<sup>1</sup>, D. H. Martz<sup>1</sup>, O. von Hofsten<sup>1</sup>, E. Fogelquist<sup>1</sup>, A. Holmberg<sup>1</sup>, U. Vogt<sup>1</sup>, H. Legall<sup>2</sup>, G. Blobel<sup>2</sup>, C. Seim<sup>3</sup>, H. Stiel<sup>2</sup>, and H. M. Hertz<sup>1</sup>*

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*<sup>2</sup>Max-Born-Institut, Max-Born-Straße 2A, 12489 Berlin, Germany*

*<sup>3</sup>Institute of Optics and Atomic Physics - Analytical X-ray physics, Technische Universität Berlin, 10623 Berlin, Germany*

### **Whole Cell Cryogenic Soft X-ray Tomography with a Laboratory Light Source (S21)** (Invited Paper)

*D.B. Carlson<sup>1</sup>, J. Gelb<sup>2</sup>, V. Palshin<sup>2</sup> and J.E. Evans<sup>1,3,\*</sup>*

*<sup>1</sup>Dept. of Molecular and Cellular Biology, University of California at Davis, Davis, CA, USA*

*<sup>2</sup>Xradia, Inc., Pleasanton, CA, USA*

*<sup>3</sup>Pacific Northwest National Lab, Environmental Molecular Sciences Lab, Richland, WA, USA*

### **Capillary Plasma Radiation Source in the Soft X-Ray Region (S17)**

*Pavel Vrba<sup>1</sup>, Miroslava Vrbova<sup>2</sup>, Sergey V. Zakharov<sup>3</sup>, Vasiliy S. Zakharov<sup>3,4</sup>, Alexandr Jancarek<sup>5</sup>, Michal Nevrkla<sup>5</sup>*

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*<sup>5</sup> Czech Technical University, Faculty of Nuclear Sci. and Phys. Engineering, 115 19 Prague 1, Czech Republic*

### **XUV and EUV Applications with EUV Sources for Metrology (S46)** (Invited Paper)

*Rainer Lebert, Thomas Mißalla, Azadeh Farahzadi, Christoph Phiesel, Urs Wiesemann, and Wolfgang Diete*

*Bruker Advanced Supercon GmbH, Waltherstrasse 49-51, 51069 Köln-Dellbrück, Germany*



## **12:40 PM Workshop Summary and Announcements**

[Workshop Summary and Announcements](#) (Summary-Source Workshop)  
*Vivek Bakshi, EUV Litho, Inc.*

## **1:00 PM Workshop Adjourned**

