

2011 International Workshop on EUV and Soft X-Ray Sources

November 7-10, 2011

Dublin ■ Ireland

Workshop Proceedings



2011 Source Workshop Proceedings



Group Photograph

Workshop Sponsors



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FIRE
Fluid, Ions and Radiation Ensemble
in Integrated Plasma Modeling



Agenda Outline

Monday, November 7, 2011

Location: Newman House, Stephen's Green, Dublin

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

Tuesday, November 8, 2011

**Location: Astra Hall (Student Union Building),
UCD Campus, Dublin**

7:45 AM Pickup at the Hotel (Stephen's Green
and Burlington Hotel)

8:30 AM – 11:30 AM Workshop Presentations

11:50 AM -12:30 PM Lunch

1:00 PM – 4:30 PM Workshop Presentations

5:45 PM – 7:00 PM Poster Session and Reception

7:00 PM Depart for Off-Site Dinner at Clarence
Hotel (Pickup at Astra Hall)

Wednesday, November 9, 2011

**Location: Astra Hall (Student Union Building),
UCD Campus, Dublin**

7:45 AM	Pickup at the Hotel (Stephen's Green and Burlington)
8:30 AM – 12:35 PM	Workshop Presentations
12:20 PM - 1:20 PM	Lunch
1:20 PM - 3:05 PM	Workshop Presentations
3:15 PM	Depart for tour of Dublin Castle (Pickup at Astra Hall)

Thursday, November 10, 2011

Location: Newman House, Stephen's Green, Dublin

Technical Working Group (TWG) Meeting

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



WORKSHOP PROCEEDINGS

2011 International Workshop on EUV and Soft X-Ray Sources

November 7-10, 2011, Dublin, Ireland

Monday, November 7, 2011 (Newman House)

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

Tuesday, November 8, 2011 (Astra Hall)

8:30 AM Welcome and Announcements

[Introduction and Announcements](#) (Intro-1)
Vivek Bakshi, EUV Litho, Inc., USA

8:35 AM Plenary Talk

[Current Status and Future of EUV and BEUV Sources](#) (S9)
Konstantin Koshelev, ISAN, Russia

9:05 AM Session 1: 6.x nm BEUV Sources

Session Chairs: Padraig Dunne (UCD)

[Recent Progress of Beyond EUV \(BEUV\) Sources](#) (S40) (Invited)
Takeshi Higashiguchi, Utsunomiya University, Japan

[Conversion Efficiency of 6.X nm Emitted From Nd: YAG and CO2 Laser Produced Plasma](#) (S29)
Shinsuke Fujioka, Osaka University, Japan



Experimental and Theoretical Studies of Gd and Tb radiation in 6.X spectral Region (S35) (Invited)
Vladimir Krivtsun, ISAN, Russia

9:55 AM Break (15 Minutes)

10:10 AM Session 2: 13.5 nm EUV Sources for HVM

Session Chairs: Vadim Banine (ASML) and Akira Endo (Waseda University)

20 minute presentations

EUV Lithography and EUV Sources (S8) (Invited)
Vadim Banine, ASML

EUV Lithography Light Source Power Scaling in Practice - LDP Source Development at XTREME Technologies (S45) (Invited)
Harald Verbraak, Xtreme Technologies, Germany

Ionization Dynamics in the Laser Plasma in Gases and a Possible Way for Optimization of the EUV Source (S25)
Serguei Kalmykov, Ioffe Physical-Technical Institute, Russia

Towards 20kW CO₂ Laser System for Sn-LPP EUV source – Recent Developments (S38)
Krzysztof M Nowak, Gigaphoton, Japan

Physical Aspects of Pre-pulsed Tin Micro Droplet in Transport Magnetic Field (S19) (Invited)
Akira Endo, Waseda University, Japan

11:50 AM LUNCH (40 Minutes)



12:30 PM Session 3: EUV Sources for EUV Metrology

Session Chairs: Sergey Zakharov (NanoUV) and Takeshi Higashiguchi (Utsunomiya University)

20 minute Presentations

A Novel High Average Power High Brightness Soft X-ray Source Using a Thin Disk Laser System for Optimized Laser Produced Plasma Generation

(S30) (Invited)

Ioanna Mantouvalou, Max-Born Institute, Germany

High brightness EUV source for EUVL applications (S32) (Invited)

Oran Morris, Adlyte, Switzerland

High brightness Electrodeless Z-Pinch™ EUV Source for Mask Inspection Tools (S46) (Invited)

Deborah Gustafson, Stephen Horne, Energetiq, USA

High Brightness Source Collector Module for EUV Metrology (S51)

Ken Fahy, NewLambda Technologies, Ireland

High Brightness EUV Light Source for Actinic Inspection & Microscopy (S43)

(Invited)

Sergey V. Zakharov, NanoUV, France

2:10 PM Break (15 Minutes)

2:25 PM Session 4: FIRE SESSION (Modeling)

Session Chairs: Gerry O’Sullivan (UCD) and Vladimir Novikov (KIAM)

20 minute presentations

Non-LTE Plasma Modeling with Cretin (S55) (Invited)

Howard Scott, LLNL, USA

Plasma Source Modeling for Future Lithography at 6.7 nm and Other Applications (S18)

Gerry O’Sullivan, UCD, Ireland

Modeling of “Mist Target” – the Ideal Target for LPP Source (S33)

Vladimir Ivanov, ISAN, Russia



Peculiarities of Modeling LPP Source at 6.X nm (S36) (Invited)

Vladimir Novikov, KIAM, Russia

Benchmarking Atomic Processes and Atomic Spectra for the Modeling of EUV Sources (S13)

Akira Sasaki, JAEA, Japan

Properties of High Intensity Radiation Plasma Sources (S44) (Invited)

Sergey V. Zakharov, EPPRA and NanoUV, France

4:25 PM Session 5: Alternative Concepts for EUV Sources

Session Chairs: Igor Pogorelsky (BNL) and Mikhail Yurkov (DESY)

15 Minute Presentations

A Kilowatt-scale Free Electron Laser Driven by L-band Superconducting Linear Accelerator Operating in a Burst Mode (S15) (Invited)

Mikhail Yurkov, DESY, Germany

Project of Acceleration Complex for Extreme Ultraviolet Nanolithography Based on a Free Electron Laser (S27)

E. M. Syresin, Joint Institute for Nuclear Research, Russia

Pushing the Limits of Laser Synchrotron Light Sources (S12) (Invited)

Igor Pogorelsky, BNL, USA

A Rotamak EUV Source (S20)

Masami Ohnishi, Kansai University, Japan

First Demonstration of Pump and Probe Experiment for Wide-gap Semiconductors Using Free Electron Laser and Synchronously-operated Femtosecond Laser (S22)

Nobuhiko Sarukura, Osaka University, Japan

5:45 PM – 7:00 PM Session 6: Poster Session

7:00 PM Depart for Dinner

End of Day 2



5:45 PM Session 6: Poster Session

Topic: HVM Sources

1) Time Resolved EUV Spectra of Laser Produced Tin Plasmas (S59)

Paddy Haydon, DCU, Ireland

2) Diagnostics Tools for EUV and BEUV Radiating Plasmas (S37)

A. Lash, ISAN, Russia

3) Investigation of spatial and spectral characteristics of EUV emission from Laser Assisted Vacuum Arc (S53)

BEST POSTER AWARD WINNER - FIRST PLACE

Isaac Tobin, Trinity College Dublin, Ireland

Topic: 6.x nm BEUV Sources

4) Basic Research on 6.x nm EUV Generation by Laser Produced Plasma (S26)

Tsukasa Hori, Gigaphoton, Japan

5) Spectral Analysis of EUV Emissions from Lanthanide Metal Atomic Ions in Large Helical Devices (LHD) Plasmas (S31)

Fumihiro Koike, Kitasato University, Japan

6) Extreme Ultraviolet Source at 6.7 nm Based on a Low-density Plasma (S41)

BEST POSTER AWARD WINNER - SECOND PLACE

Takamitsu Otsuka, Utsunomiya University, Japan

7) Investigating the Effects of Laser Power Density and Pulse Duration on the 6.7-nm BEUV Emission (S48)

BEST POSTER AWARD - SECOND PLACE

Thomas Cummins, UCD, Ireland

8) The Effect of Viewing Angle on EUV Spectra of Laser Produced Gadolinium Plasmas (S49)

Colm O'Gorman, UCD, Ireland

Topic: EUV Sources for Metrology

9) Development of Novel EUV Source Collector Module Using a Tin Based Liquid Metal Alloy (S50)

Paul Sheriden, NewLambda Technologies, Ireland

Topic: Modeling

10) Radiance of Non-equilibrium Gd Plasma (S42)

Vasily S. Zakharov, EPPRA, France

Topic: Alternative Concepts / Non-EUVL Applications of EUV Sources

11) The Anisotropy of the EUV Radiation from the Plasma of the High-current Pulse Plasma Diode (S23)

Ievgeniia Borgun, Kharkov National University, Ukraine

12) Development of a 10 μ m Optical Storage Cavity (S28)

Kazuyuki Sakaue, Waseda University, Japan

13) Radiation Sources in the Extreme Ultraviolet and Soft X-ray Region (S52)

Deirdre Kilbane, UCD, Ireland

Wednesday, November 9, 2011

8:30 AM Announcements

Introduction and Announcements (Intro-2)

Vivek Bakshi, EUV Litho, Inc.

8:35 AM Keynote Presentations

SFI - Promoting Science in Ireland (S2)

Aisling McEvoy, SFI, Ireland

IAPP Program Review (S1)

Laura Apostol, IAPP, EU

9:35 AM Session 7: Business Presentations

Session Chair: Vivek Bakshi, EUV Litho, Inc.

15 Minute Presentations

Foreign Direct Investment (S5)

Donald Flavin, IDA, Ireland

Innovation – The 3rd Pillar at University College Dublin (S7)

Peter Clinch, UCD

10:05 AM Break (15 Minutes)

10:20 AM Session 8: Multilayer Optics

Session Chairs: Sasa Bajt (DESY) and Eric Louis (FOM)

20 Minute Presentations

Multilayer Mirrors for Free Electron Laser Applications (S21) (Invited)

Sasa Bajt, DESY



Corrosion-resistant Multilayer Coatings for the 28-50 nm Wavelength Region (S17) (Invited)
Regina Soufli, LLNL, USA

Multilayer Design for EUV lithography (S39)
M.G. Pelizzo, LUXOR CNR, Italy

Multilayer Coating for EUV Collector Mirrors (S16) (Invited)
Hagen Pauer, Fraunhofer, Germany

Multilayers for Present and Future Generations of EUVL (S56) (Invited)
Yuriy Platonov, RIT, USA

Multilayer Development for Extreme Ultraviolet and Shorter Wavelength Lithography (S24) (Invited)
Eric Louis, FOM, Netherlands

12:20 PM Lunch (60 Minutes)

1:20 PM Session 9: Soft X-Ray Sources for Non-Semiconductor Applications

Session Chairs: *Dimitri Scholz (UCD) and Larissa Juschkin (RWTH-TOS)*

20 Minute Presentations

The EUV Laser Program at the University of Bern: Bridging the Gap between Tools and Applications (S11)
Davide Bleiner, University of Bern

EUV Microscopy - a User's Perspective (S57)
Dimitri Scholz, UCD, Ireland

Demonstration of a High-brightness Water-window Laser-plasma Source for Soft x-ray microscopy (S14)
Dale Martz, KTH, Sweden

Soft X-ray Source Development at Energetiq Technology (S47)
Deborah Gustafson, Stephen Horne, Energetiq, USA

Light for the Nano-world (S54)
Larissa Juschkin, RWTH-TOS (Germany)



2:55 PM Workshop Summary and Announcements

Workshop Summary and Announcements (Summary-Source Workshop)
Vivek Bakshi, EUV Litho, Inc.

3:15 PM Workshop Adjourned (Leave for Tour of Dublin Castle)

