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LASER DAMAGE.

**TECHNICAL
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**XLVII ANNUAL SYMPOSIUM ON OPTICAL
MATERIALS FOR HIGH-POWER LASERS**

National Institute of
Standards and Technology
Boulder, Colorado, USA
Conference: 27-30 September 2015



SPIE. LASER DAMAGE

XLVII ANNUAL SYMPOSIUM ON OPTICAL MATERIALS FOR HIGH-POWER LASERS

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**National Institute of Standards and Technology
Boulder, Colorado, USA**

Contents

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Welcome

Welcome to the 47th Annual Symposium on Optical Materials for High-Power Lasers—the leading forum for the exchange of information on the physics/technology of materials for high-power/high-energy lasers. The series of conference proceedings has grown to be a comprehensive source of information on optics for lasers and includes topics on laser-induced damage mechanisms, materials and thin film preparation, durability, properties modeling, testing, and component fabrication. This symposium includes both oral and poster presentations with no parallel sessions. This year, the Tutorial is on Defect-Induced Damage in Nano- and Femtosecond Regime, chaired by Dr. Laurent Gallais. Distinguished international researchers in the field of optics for high-power/high-energy lasers will present invited talks. We have planned 3.5 days of information, networking, and enjoyment.

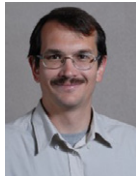
We welcome you to Boulder!



CONFERENCE CHAIRS



Gregory J. Exarhos
Pacific Northwest
National Lab.
(USA)



Vitaly E. Gruzdev
Univ. of Mis-
souri-Columbia
(USA)



Joseph A. Menapace
Lawrence Liver-
more National
Lab. (USA)



Detlev Ristau
Laser Zentrum
Hannover e.V.
(Germany)



MJ Soileau
Univ. of Central
Florida (USA)

INTERNATIONAL PROGRAM COMMITTEE

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Hannover e.V. (Germany)
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Semyon Papernov, Univ. of
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Wolfgang Rudolph, The Univ. of
New Mexico (USA)

Jianda Shao, Shanghai Institute of
Optics and Fine Mechanics (China)

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Jefferson National Accelerator
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Pacific Northwest National
Lab.

Lab. for Laser Energetics, Univ.
of Rochester

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NIST TECHNICAL SPONSOR

Joshua Hadler

CONFERENCE SITE

Monday – Wednesday
NIST Building 1 (Radio Bldg.)
325 Broadway
Boulder, Colorado, USA
www.boulder.nist.gov

SUNDAY EVENTS HOTEL

Boulder Marriott
2660 Canyon Blvd.
Boulder, Colorado, USA
Tel: 303 440 8877

HOTEL AND LODGING ACCOMMODATIONS

Hotel and Travel Information:
www.spie.org/ld
Visit boulderlodging.com

QUESTIONS?

SPIE, PO Box 10,
Bellingham, WA 98227-0010 USA
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help@spie.org
Tel: +1 360 676 3290
Fax: +1 360 647 1445

SPECIAL EVENTS

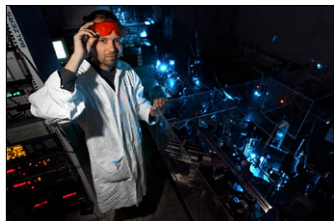
Sunday 27 September

TUTORIAL ON

Defect-induced damage in nano- and femtosecond regime

6:00 to 7:00 pm

Location: Boulder Marriott, Montrachet Room (1st floor)



Chaired by: **Dr. Laurent Gallais**,
Institut Fresnel (France)

This tutorial is focused on the fundamental effects and basic physics of laser-defect interactions with nanosecond and femtosecond laser pulses. It also will include statistical effects in laser-damage-threshold metrology, and implica-

tions of defects (including artificial ones) for applications.

Welcome and Social Mixer

7:00 to 8:30 pm

Location: Boulder Marriott, Montrachet Room (1st floor)

Join your colleagues for light refreshments and mingling.

Guest tickets are available onsite for purchase, \$25.

Registration Material Pick-up will available 5:30 to 8:30 pm.

Monday 28 September

Open House and Reception

6:30 to 8:00 pm

Come, relax, and join your colleagues at ATFilms for an enjoyable evening of refreshments and pleasant conversation. Invitation and Driving Instructions included in Registration Packet.

SPONSORED BY: **ADVANCED
THIN FILMS**

Tuesday 29 September

Wine and Cheese Tasting Reception

6:30 to 8:00 pm

SPONSORED BY: **SPIE** and
the Conference Co-chairs of Laser Damage XLVII

Reception at NCAR

1850 Table Mesa Dr., Boulder, CO

All attendees are invited to join us in an amazing location for an enjoyable evening of wine tasting, local brews, and a selection of cheese appetizers.

FOOD AND DRINK SPONSORED BY :



SPECIAL EVENTS

Wednesday 30 September

NIST Facility Tours

12:40 to 1:40 pm

NIST has generously offered to provide 2 limited tours of the facility, including the **NIST-F2 Atomic Clock** and the **NIST Laser Welding Lab**.

Space is limited. Sign up onsite by 2:00 pm on Tuesday to reserve your place. First come, first served for Laser Damage Attendees only. A sign-up sheet will be at the registration desk.



Celebrate with us

The International Year of Light is a global initiative highlighting to the citizens of the world the importance of light and light-based technologies in their lives, for their futures, and for the development of society.



INTERNATIONAL
YEAR OF LIGHT
2015



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**Femto-Solid
Dynamics
Laboratory**

CONFERENCE 9632

Sunday–Wednesday 27–30 September 2015
Proceedings of SPIE Vol. 9632

Laser-Induced Damage in Optical Materials: 2015

Conference Chairs: **Gregory J. Exarhos**, Pacific Northwest National Lab. (USA); **Vitaly E. Gruzdev**, Univ. of Missouri-Columbia (USA); **Joseph A. Menapace**, Lawrence Livermore National Lab. (USA); **Detlev Ristau**, Laser Zentrum Hannover e.V. (Germany); **MJ Soileau**, Univ. of Central Florida Office of Research & Commercialization (USA)

Program Committee: **Detlev Ristau**, Laser Zentrum Hannover e.V. (Committee Chair) (Germany); **James E. Andrew**, AWE plc (United Kingdom); **Jonathan W. Arenberg**, Northrop Grumman Aerospace Systems (USA); **Mireille Commandré**, Institut Fresnel (France); **Stavros G. Demos**, Lawrence Livermore National Lab. (USA); **Leonid B. Glebov**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Takahisa Jitsuno**, Osaka Univ. (Japan); **Klaus Mann**, Laser-Lab. Göttingen e.V. (Germany); **Carmen S. Menoni**, Colorado State Univ. (USA); **Masataka Murahara**, Tokai Univ. (Japan); **Jérôme Néauport**, Commissariat à l'Énergie Atomique (France); **Semyon Papernov**, Univ. of Rochester (USA); **Wolfgang Rudolph**, The Univ. of New Mexico (USA); **Jianda Shao**, Shanghai Institute of Optics and Fine Mechanics (China); **Michelle D. Shinn**, Thomas Jefferson National Accelerator Facility (USA); **Christopher J. Stolz**, Lawrence Livermore National Lab. (USA)

SUNDAY 27 SEPTEMBER

SUNDAY EVENTS

Boulder Marriott,
2660 Canyon Blvd., Boulder, Colorado

REGISTRATION MATERIAL PICK-UP

Location: Montrachet Room (1st Floor) . . . 5:30 pm to 8:30 pm

NIST Security Badges will be available for attendees
with a passport or photo ID.

TUTORIAL

Location: Montrachet Room, 1st Floor . 6:00 pm to 7:00 pm

Defect-Induced Damage in Nano- and Femtosecond Regime

Moderator: **Dr. Laurent Gallais**, Institut Fresnel (France)

This tutorial is focused on the fundamental effects and basic physics of laser-defect interactions with nanosecond and femtosecond laser pulses. It also will include statistical effects in laser-damage-threshold metrology, and implications of defects (including artificial ones) for applications.

WELCOME AND SOCIAL MIXER

Location: Montrachet Room (1st Floor) . . . 7:00 pm to 8:30 pm

Join your colleagues for light refreshments, appetizers, and mingling.

Registration Material Pick-up continues until 8:30 pm.

Download Technical Abstract Book at
www.spie.org/ld

CONFERENCE 9632

MONDAY 28 SEPTEMBER

CONFERENCE LOCATION

NIST, Building 1 (Radio Bldg.),
324 Broadway, Boulder, Colorado

REGISTRATION MATERIAL PICK-UP

Location: NIST Lobby Area 7:30 am to 4:00 pm

Attendees must check in with NIST Security at entrance and have photo identification available. Please allow 15 minutes for extra time on Monday morning.

POSTER PLACEMENT AT NIST

Location: Rooms 1&2 7:50 am to 8:30 am

OPENING REMARKS, 2014 AWARD PRESENTATIONS

Location: NIST Auditorium 8:30 am to 9:00 am

2014 Best Paper Award Winners

BEST ORAL PRESENTATION

Ultrafast optical breakdown of multilayer thin-films at kHz and MHz repetition rates: a direct comparison [9237-16]

Ivan B. Angelov, Max-Planck-Institut für Quantenoptik (Germany); **Michael K. Trubetskov**, Max-Planck-Institut für Quantenoptik (Germany) and Moscow State Univ. (Russian Federation); **Vladislav S. Yakovlev**, Max-Planck-Institut für Quantenoptik (Germany) and Ludwig-Maximilians-Univ. München (Germany); **Olga Razskazovskaya**, Max-Planck-Institut für Quantenoptik (Germany); **Martin Gorjan**, Max-Planck-Institut für Quantenoptik (Germany) and Ludwig-Maximilians-Univ. München (Germany); **Helena G. Barros**, Ludwig-Maximilians-Univ. München (Germany); **Ferenc Krausz**, Max-Planck-Institut für Quantenoptik (Germany) and Ludwig-Maximilians-Univ. München (Germany); **Vladimir Prevak**, Ludwig-Maximilians-Univ. München (Germany) and UltraFast Innovations GmbH (Germany)

BEST POSTER PRESENTATION

Repair of a mirror coating on a large optic for high laser-damage applications using ion milling and over-coating methods [9237-51]

Ella S. Field, John C. Bellum, Damon E. Kletecka, Sandia National Labs. (USA)

LOCATION: NIST AUDITORIUM

SESSION 1

Location: NIST Auditorium Mon 9:00 am to 10:00 am

Thin Films I

Session Chairs: **MJ Soileau**, Univ. of Central Florida (USA);
Vitaly E. Gruzdev, Univ. of Missouri (USA)

9:00 am: **Dispersive dielectric mirror for ultrashort-pulse laser at high intensities** (*Keynote Presentation*), Vladimir Pervak, Ludwig-Maximilians-Univ. München (Germany) [9632-1]

9:40 am: **Comparative study of the laser damage threshold and optical characteristics of Ta₂O₅-SiO₂ multilayers deposited using various methods**, Roelene Botha, Interstaatliche Hochschule für Technik Buchs NTB (Switzerland) and RhySearch (Switzerland); Silvia Schwyn Thöny, Evatec Ltd. (Switzerland); Martin Grössl, Safer Mourad, FISBA OPTIK AG (Switzerland); Clau Maissen, Jacobus I. Venter, SwissOptic AG (Switzerland); Martin Hoffmann, Univ. of Neuchâtel (Switzerland); Pavel V. Bulkin, Ecole Polytechnique (France); Sabine Linz-Dittrich, David Bischof, Markus Michler, Stefan J. Rinner, Andreas Ettemeyer, Interstaatliche Hochschule für Technik Buchs NTB (Switzerland) [9632-2]

MONDAY POSTER OVERVIEWS

Location: NIST Auditorium 10:00 am to 10:40 am

Poster authors are asked to give a 2-minute/2-viewgraph overview of their posters in the order that they appear in the Monday poster sessions.

POSTER VIEWING AND REFRESHMENT BREAK – MONDAY AM

Location: Rooms 1&2 10:40 am to 11:40 am

Posters will be displayed for viewing during refreshment breaks on Monday from 10:40 am to 11:40 am and again from 4:00 pm to 4:50 pm.

Thin Films

How reduced vacuum pumping capability in a coating chamber affects the laser damage resistance of HfO₂/SiO₂ antireflection and high-reflection coatings, Ella S. Field, John C. Bellum, Damon E. Kletecka, Sandia National Labs. (USA) [9632-46]

CONFERENCE 9632

Ion-beam sputtered HfO_2 - SiO_2 mixtures and their application for high laser-damage threshold multilayer coatings for 266nm wavelength????, Giedrius Abromavicius, Ramutis Drazdys, Kestutis Juskevicius, Danute Bakaityte, Rytis Buzelis, Ctr. for Physical Sciences and Technology (Lithuania); Irmantas Kakaras, Optida Co., Ltd. (Lithuania) [9632-48]

Control of the coating stress using a different deposition method, Takuma Murakami, Masaya Akimoto, Hiroki Omatsu, Tomosumi Kamimura, Osaka Institute of Technology (Japan) [9632-49]

Ultrafast beam dump materials and mirror coatings tested with the ELI beamlines LIDT test station, Michal Durák, Daniel Kramer, Galina Kalinchenko, Tomáš Medrík, Jan Hřebíček, Jirí Golasowski, Václav Štěpán, Michaela Kozlová, Bedrich Rus, Academy of Sciences of the Czech Republic (Czech Republic) [9632-50]

Test station development for laser-induced optical damage performance of broadband multilayer dielectric coatings, Kyle R. P. Kafka, Enam Chowdhury, The Ohio State Univ. (USA); Raluca A. Negres, Christopher J. Stolz, Jeffrey D. Bude, Andy J. Bayramian, Christopher D. Marshall, Thomas M. Spinka, Constantin L. Haefner, Lawrence Livermore National Lab. (USA) [9632-51]

Measurement and compensation of wavefront deformations and focal shifts in high-power laser optics, Klaus Mann, Bernd Schäfer, Martin Stubenvoll, Laser-Lab. Göttingen e.V. (Germany) [9632-52]

Design and laser damage properties of a dichroic beam combiner coating for 22.5° incidence and S polarization with high-transmission at 527nm and high-reflection at 1054nm, John C. Bellum, Ella S. Field, Damon E. Kletecka, Patrick K. Rambo, Ian C. Smith, Sandia National Labs. (USA) [9632-82]

Materials and Measurements

Improved parametric spectroscopic performance of an optical fiber doped with erbium, Ghoumazi Mehdi, Nacer-Eddine Demagh, Azzedine Adouane, Badreddine Boubir, Abdel Kader Daoui, Ctr. de Développement des Technologies Avancées (Algeria) [9632-53]

Analysis of cumulative versus ISO-recommended calculation of damage probability using a database of real S-on-1 tests, Alexandru Zorila, Aurel Stratan, Ioana Dumitrache, Laurentiu Rusen, National Institute for Laser, Plasma and Radiation Physics (Romania); George Nemes, ASTIGMAT (USA) [9632-54]

Synthesis of Nd-doped $\text{Y}_3\text{Sc}_x\text{Al}_{[5-x]}\text{O}_{12}$ ($x = 0$ to 2) composite ceramics with spectrum broadening and their damage resistance, Yuki Tamura, Takuya Kiriyama, Kazuki Kitabayashi, Kosuke Nuno, Tomosumi Kamimura, Osaka Institute of Technology (Japan); Yan Lin Aung, Akio Ikesue, World Lab Co., Ltd. (Japan) [9632-55]

LOCATION: NIST AUDITORIUM

Lowering evaluation uncertainties in laser-induced damage testing, Lars O. Jensen, Marius A. Mrohs, Mark Gyamfi, Heinrich Mädebach, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) [9632-57]

The role of fluence selection in the convergence and uncertainty of sensitivity measurements of laser damage behavior, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Michael D. Thomas, Spica Technologies, Inc. (USA) [9632-58]

An empirical investigation of the laser survivability curve: VI-nanosecond pulse widths, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Wolfgang Riede, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Alessandra Ciapponi, European Space Research and Technology Ctr. (Netherlands); Paul Allenspacher, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Jonathan H. Herringer, Arrow Thin Films, Inc. (USA); Denny Wernham, European Space Research and Technology Ctr. (Netherlands) [9632-59]

An empirical investigation of the laser survivability curve: VI-femtosecond pulse widths, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Andrius Melninkaitis, Vilnius Univ. (Lithuania); Wolfgang Riede, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Allesandra Ciapponi, European Space Agency (Netherlands) and European Space Research and Technology Ctr. (Netherlands); Paul Allenspacher, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Jonathan H. Herringer, Arrow Thin Films, Inc. (USA); Denny Wernham, European Space Agency (Netherlands) [9632-60]

Direct comparison of statistical damage frequency method and raster scan procedure, Gintare Bataviciute, Mindaugas Šciuka, Viktorija Plerpaite, Andrius Melninkaitis, Vilnius Univ. (Lithuania) [9632-61]

Characterization of damage precursor density from laser damage probability measurements with non-Gaussian beams, Frank R. Wagner, Institut Fresnel (France); Andrius Melninkaitis, Gintare Bataviciute, Vilnius Univ. (Lithuania); Céline Gouldieff, Alexandre Beaudier, Institut Fresnel (France); Linas Smalakys, Vilnius Univ. (Lithuania); Jean-Yves Natoli, Institut Fresnel (France) [9632-62]

Transmittance measurements of laser components using a combination of cavity ring-down and photometry, Bincheng Li, Institute of Optics and Electronics (China) and Univ. of Electronic Science and Technology of China (China); Hao Cui, Univ. of Electronic Science and Technology of China (China) and Institute of Optics and Electronics (China); Yanling Han, Institute of Optics and Electronics (China); Chunming Gao, Yafei Wang, Univ. of Electronic Science and Technology of China (China) [9632-63]

CONFERENCE 9237

SESSION 2

Location: NIST Auditorium Mon 11:40 am to 1:00 pm

Thin Films II

Session Chairs: **Stavros G. Demos**,
Lawrence Livermore National Lab. (USA); **Jérôme Néauport**,
Commissariat à l'Énergie Atomique (France)

11:40 am: **Investigating the relationship between material properties and laser-induced damage threshold of amorphous dielectric optical coatings at 1064 nm**, Riccardo Bassiri, Stanford Univ. (USA); Iain W. Martin, Univ. of Glasgow (United Kingdom); Caspar C. Clark, Helia Photonics Ltd. (United Kingdom); Ashot S. Markosyan, Stanford Univ. (USA); Sheila Rowan, Univ. of Glasgow (United Kingdom); Martin M. Fejer, Stanford Univ. (USA) [9632-3]

12:00 pm: **Influence of different-sized femtosecond fabricated substrate pits on nanosecond-laser-induced-damage in high-reflective mirrors**, Yingjie Chai, Meiping Zhu, Kui Yi, Weili Zhang, Yuanan Zhao, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) [9632-4]

12:20 pm: **Picosecond laser damage performance of the multilayer dielectric pulse compressor gratings and high reflectors for the advanced radiographic capability Petawatt laser system**, Raluca A. Negres, Isaac L. Bass, Kenneth A. Stanion, Gabriel M. Guss, David A. Cross, David A. Alessi, Jerald A. Britten, Christopher J. Stolz, Paul J. Wegner, Lawrence Livermore National Lab. (USA) [9632-5]

12:40 pm: **A comparative study of the laser-induced damage characteristics of artificial nodules prepared by different processes**, Xinbin Cheng, Hongping Ma, Abudusalamu Tuniyazi, Tongji Univ. (China); Yongjian Tang, China Academy of Engineering Physics (China); Zhanshan Wang, Tongji Univ. (China) [9632-6]

Lunch Break Mon 1:00 pm to 2:20 pm

LOCATION: NIST AUDITORIUM

SESSION 3

Location: NIST Auditorium Mon 2:20 pm to 4:00 pm

Thin Films III

Session Chairs: **Wolfgang Rudolph**,
The Univ. of New Mexico (USA); **Joseph A. Menapace**,
Lawrence Livermore National Lab. (USA)

2:20 pm: **Impact of laser-contaminant interaction on the performance of the protective cap layer of 1w HR mirror coatings**, Siping R. Qiu, Mary A. Norton, Rajesh N. Raman, Alexander M. Rubenchik, Lawrence Livermore National Lab. (USA); Amy L. Rigatti, Univ. of Rochester (USA); Paul B. Mirkarimi, Christopher J. Stolz, Manyalibo J. Matthews, Charles D. Boley, Lawrence Livermore National Lab. (USA) [9632-7]

2:40 pm: **Laser damage resistant interference coatings for 1.6 μm wavelength operation**, Drew D. Schiltz, Dinesh Patel, Cory Baumgarten, Brendan A. Reagan, Jorge J. Rocca, Carmen S. Menoni, Colorado State Univ. (USA) [9632-8]

3:00 pm: **Sheet resistivity and optical absorption of Al-doped ZnO thin films: a “conductive” layer to reduce the charging effects**, Ashot S. Markosyan, Riccardo Bassiri, Stanford Univ. (USA); Ric P. Shimshock, MLD Technologies, LLC (USA); Brian T. Lantz, Roger Route, Martin M. Fejer, Stanford Univ. (USA) [9632-9]

3:20 pm: **The role of film interfaces in near-ultraviolet absorption and pulsed-laser damage in ion-beam-sputtered coatings based on $\text{HfO}_2/\text{SiO}_2$ thin-film pairs**, Semyon Papernov, Alexei A. Kozlov, James B. Oliver, Christopher Smith, Univ. of Rochester (USA); Lars O. Jensen, Detlev Ristau, Stefan Günster, Heinrich Mädebach, Laser Zentrum Hannover e.V. (Germany) [9632-10]

3:40 pm: **Broadband low-dispersion mirror thin film damage competition**, Christopher J. Stolz, Lawrence Livermore National Lab. (USA); Kyle R. P. Kafka, Enam Chowdhury, The Ohio State Univ. (USA); Matthew S. Kirchner, Kapteyn-Murnane Labs., Inc. (USA) [9632-11]

POSTER VIEWING AND REFRESHMENT BREAK – MONDAY PM

Location: Rooms 1&2 Mon 4:00 pm to 4:50 pm

Poster Viewing and Refreshment Break

Posters will be displayed for viewing during refreshment breaks on Monday from 10:40 am to 11:40 am and again from 4:00 pm to 4:50 pm.

CONFERENCE 9632

SESSION 4

Location: NIST Auditorium Mon 4:50 pm to 5:50 pm

Surfaces, Mirrors, and Contamination I

Session Chairs: **Carmen S. Menoni**, Colorado State Univ. (USA);
Semyon Papernov, Univ. of Rochester (USA)

4:50 pm: **Volume holographic elements for high-power laser applications** (*Keynote Presentation*), Leonid B. Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and OptiGrate Corp. (USA) [9632-12]

5:30 pm: **Dedicated contamination experiments in the Orion laser target chamber**, James E. Andrew, AWE plc (United Kingdom). [9632-13]

CLOSING REMARKS

Location: NIST Auditorium Mon 5:50 pm to 6:00 pm

Open House and Reception

MON 6:30 TO 8:00 PM

Come, relax, and join your colleagues at ATFilms for an enjoyable evening of refreshments and pleasant conversation.

Invitation and Driving Instructions included in Registration Packet.

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LOCATION: NIST AUDITORIUM

TUESDAY 29 SEPTEMBER

REGISTRATION MATERIAL PICK-UP

Location: NIST Lobby Area Tue 7:30 am to 4:00 pm

Attendees must check in with NIST Security at entrance and have photo identification available.

POSTER PLACEMENT AT NIST

Location: Rooms 1&2 Tue 7:50 am to 8:30 am

SESSION 5

Location: NIST Auditorium Tue 8:30 am to 10:10 am

Surfaces, Mirrors, and Contamination II

Session Chairs: **Christopher J. Stolz**,
Lawrence Livermore National Lab. (USA);
Gregory J. Exarhos, Pacific Northwest National Lab. (USA)

8:30 am: **Study of laser-induced damage at 1064nm in fused silica samples in vacuum environment**, Romain Diaz, Maxime Chambonneau, Pierre Grua, Jean-Luc Rullier, Commissariat à l'Énergie Atomique (France); Jean-Yves Natoli, Institut Fresnel (France); Laurent Lamaignère, Commissariat à l'Énergie Atomique (France) [9632-14]

8:50 am: **Laser-induced damage of fused silica on high-power laser: beam intensity modulation, optics imperfection, contamination**, Dongfeng Zhao, Shanghai Institute of Optics and Fine Mechanics (China) [9632-15]

9:10 am: **Laser-induced shallow pits on silica output surfaces: formation and resulting light scattering**, Eyal Feigenbaum, Rajesh N. Raman, Norman D. Nielsen, Manyalibo J. Matthews, Lawrence Livermore National Lab. (USA) [9632-16]

9:30 am: **Sub-wavelength microstructures for high-power laser application on fused silica**, Ye Xin, Jin Huang, Ruifang Ni, Laixi Sun, Xiaodong Jiang, Wanguo Zheng, China Academy of Engineering Physics (China) [9632-17]

9:50 am: **Effect of reaction ion etching process on laser-damage performance of fused silica optics**, Laixi Sun, Hongjie Liu, Jin Huang, Xin Ye, Xiaodong Jiang, Weidong Wu, China Academy of Engineering Physics (China) [9632-18]

CONFERENCE 9632

TUESDAY POSTER OVERVIEWS

Location: NIST Auditorium 10:10 am to 10:40 am

Poster authors are asked to give a 2-minute/2-viewgraph overview of their poster in the order that they appear in the Tuesday poster sessions.

POSTER VIEWING AND REFRESHMENT BREAK- TUESDAY AM

Location: Rooms 1&2 10:40 am to 11:40 am

Posters will be displayed for viewing during the refreshments breaks on Tuesday from 10:40 am to 11:40 am and again at 4:10 pm to 5:00 pm.

Fundamental Mechanisms

Direct absorption measurements in thin rods and optical fibers, Christian Mühligh, Simon Bublitz, Martin Lorenz, Leibniz-Institut für Photonische Technologien e.V. (Germany) [9632-64]

Bulk damage and absorption in fused silica due to high-power laser applications, Frank Nuernberg, Heraeus Quarzglas GmbH & Co. KG (Germany) [9632-65]

Refined metrology of spatio-temporal dynamics of nanosecond laser pulses: application to nonlinear Kerr effect and its influence on the measurement of laser-induced surface damage in thick fused silica window, Romain Diaz, Roger Courchinoux, Jacques Luce, Claude Rouyer, Jean-Luc Rullier, Jean-Michel Sajer, Commissariat à l'Énergie Atomique (France); Jean-Yves Natoli, Institut Fresnel (France); Laurent Lamaignère, Commissariat à l'Énergie Atomique (France) [9632-66]

Synchrotron micro-XRF study of metal inclusions distribution and variation in potassium dihydrogen phosphate (KH₂PO₄) induced by ultraviolet laser pulses, Zhiqiang Cao, Xin Ju, Chunyan Yan, Chang Liu, Univ. of Science and Technology Beijing (China) [9632-67]

Optimization of the concentration of populations of an optical fiber doped with erbium, Ghoumazi Mehdi, Nacer-Eddine Demagh, Azzedine Adouane, Badreddine Boubir, Abdel Kader Daoui, Ctr. de Développement des Technologies Avancées (Algeria) [9632-68]

Nano-Kelvin calorimeter for optical absorption spectroscopy at the level of parts per billion, Behshad Roshanzadeh, S. T. P. Boyd, Wolfgang Rudolph, The Univ. of New Mexico (USA). [9632-69]

Defects characterization of optical materials by photothermal microscopy and optical scattering microscopy, Jingtao Dong, Bingbing Li, Jian Chen, Zhouling Wu, ZC Optoelectronic Technologies, Ltd. (China) [9632-70]

Surfaces, Mirrors, and Contamination

Improving laser-damage resistance of optics by optimizing the interface structure, Xiaodong Jiang, China Academy of Engineering Physics (China) [9632-73]

Improved laser damage threshold performance of calcium fluoride optical surfaces via accelerated neutral atom beam (ANAB) processing, Michael J. Walsh Jr., Sean Kirkpatrick, Richard Svrluga, Exogenesis Corp. (USA); Michael D. Thomas, Spica Technologies, Inc. (USA) [9632-74]

Scaling of laser-induced contamination growth at 266nm and 355nm, Matthias Ließmann, Lars O. Jensen, Istvan Balasa, Michael Hunnekuhl, Alexander Büttner, Peter Wessels, Jörg Neumann, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) [9632-75]

Enhancement of surface-damage resistance by removing a polishing contamination in CaF₂ crystal, Keita Kawasaki, Yoshizumi Inagaki, Ryoya Ota, Tomosumi Kamimura, Osaka Institute of Technology (Japan) [9632-77]

Retrieval of defect densities from STEREO-LID (spatio-temporally resolved optical laser induced damage) data and comparison with traditional damage tests, Yeji Xu, Luke A. Emmert, Wolfgang Rudolph, The Univ. of New Mexico (USA) [9632-78]

SESSION 6

Location: NIST Auditorium Tue 11:40 am to 1:10 pm

Mini Symposium: Laser-Induced Damage to Multilayers in Femtosecond Regime

Session Chairs: **Vladimir Pervak**, UltraFast Innovations GmbH (Germany); **Klaus Mann**, Laser-Lab. Göttingen e.V. (Germany)

11:40 am: **Optical coatings excited by femtosecond lasers near the damage threshold: challenges and opportunities** (*Plenary*), Luke A. Emmert, Cristina Rodriguez, Zhanliang Sun, Wolfgang Rudolph, The Univ. of New Mexico (USA) [9632-19]

12:10 pm: **Analysis of energy deposition and damage mechanisms in single layers of HfO₂ and Nb₂O₅ submitted to 500fs pulses**, Dam-Bé L. Douti, Mhamad Chrayteh, Serge Monneret, Mireille Commandre, Laurent Gallais, Institut Fresnel (France) [9632-20]

CONFERENCE 9632

12:30 pm: **Ultrafast pre-damage dynamics in ultraviolet reflector**, Juan Du, Zehan Li, Shanghai Institute of Optics and Fine Mechanics (China); Bing Xue, Takayoshi Kobayashi, The Univ. of Electro-Communications (Japan); Yuanan Zhao, Yuxin Leng, Shanghai Institute of Optics and Fine Mechanics (China) [9632-21]

12:50 pm: **Laser-damage resistance of optical components in sub-picosecond regime in the infrared**, Jérôme Néauport, Martin Sozet, Commissariat à l'Énergie Atomique (France) [9632-22]

Lunch Break Tue 1:10 pm to 2:30 pm

SESSION 7

Location: NIST Auditorium Tue 2:30 pm to 4:10 pm

Fundamental Mechanisms I

Session Chairs: **Leonid B. Glebov**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA);

Semyon Papernov, Univ. of Rochester (USA)

2:30 pm: **What time-resolved measurements tell us about femtosecond laser damage?** (*Keynote Presentation*), Andrius Melninkaitis, Vilnius Univ. (Lithuania), LIDARIS Ltd. (Lithuania); Nerijus Šiaulys, Balys Momgaudis, Julius Vaicenavicius, Simona Barkauskaite, Valdas Sirutkaitis, Vilnius Univ. (Lithuania); Laurent Gallais, Ecole Centrale Marseille (France); Stéphane Guizard, Commissariat à l'Énergie Atomique (France), Ctr. National de la Recherche Scientifique (France), Ecole Polytechnique (France) [9632-23]

3:10 pm: **Laser damage threshold: useful idea or dangerous misconception?**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA) [9632-24]

3:30 pm: **Characterization of laser-induced structural modification in bulk of broken-down dielectrics**, Karol A. Janulewicz, Zia U. Rehman, Yavor V. Grigorov, Khoa A. Tran, Le T. Na, Vinh H. Nguyen, Gwangju Institute of Science and Technology (Korea, Republic of) [9632-25]

3:50 pm: **Single-shot femtosecond laser ablation of copper: experiment versus simulation**, Enam Chowdhury, Kyle R. P. Kafka, Robert A. Mitchell III, Kevin Werner, Noah Talisa, Hui Li, Allen Yi, Douglass W. Schumacher, The Ohio State Univ. (USA) [9632-26]

LOCATION: NIST AUDITORIUM

**POSTER VIEWING AND REFRESHMENT BREAK
TUESDAY PM**

Location: Rooms 1&2 4:10 pm to 5:00 pm

Posters will be displayed for viewing during refreshment breaks on Tuesday from 10:40 am to 11:40 am and again from 4:10 pm to 5:10 pm.

SESSION 8

Location: NIST Auditorium Tue 5:00 pm to 6:00 pm

Fundamental Mechanisms II

Session Chairs: **Detlev Ristau**, Laser Zentrum Hannover e.V. (Germany);
Wolfgang Rudolph, The Univ. of New Mexico (USA)

5:00 pm: **Probing the properties of laser super-heated fused silica following exit surface damage**, Stavros G. Demos, Raluca A. Negres, Rajesh N. Raman, Michael D. Feit, Kenneth R. Manes, Alexander M. Rubenchik, Lawrence Livermore National Lab. (USA) [9632-27]

5:20 pm: **Gigashot optical degradation in silica optics at 351 nm**, Sonny S. Ly, Lawrence Livermore National Lab. (USA) [9632-28]

5:40 pm: **In situ study of irradiation effects on fused silica induced by high-repetitive laser pulses at 355 nm**, Jian Chen, Jingtao Dong, Bingbing Li, Zhouling Wu, ZC Optoelectronic Technologies Ltd. (China) . . . [9632-29]

CLOSING REMARKS

Location: NIST Auditorium 6:00 pm to 6:10 pm

CONFERENCE 9632

Wine and Cheese Tasting Reception

TUE 6:30 TO 8:00 PM

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REGISTRATION MATERIAL PICK-UP

Location: NIST Lobby Area 7:30 am to 3:00 pm

Attendees must check in with NIST Security at entrance and have photo identification available.

SESSION 9

Location: NIST Auditorium Wed 8:30 am to 10:30 am

Fundamental Mechanisms III

Session Chairs: **Jonathan W. Arenberg**, Northrop Grumman Aerospace Systems (USA); **James E. Andrew**, AWE plc (United Kingdom)

8:30 am: **Energetic laser cleaning of metallic particles and surface damage on silica optics: Investigation of the underlying governing mechanisms**, Nan Shen, Stavros G. Demos, Raluca A. Negres, Alexander M. Rubenchik, Candace D. Harris, Manyalibo J. Matthews, Lawrence Livermore National Lab. (USA) [9632-30]

8:50 am: **Delay dependency of two-pulse femtosecond laser damage**, Mark Gyamfi, Peter Juergens, Lars O. Jensen, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) [9632-31]

9:10 am: **Self-consistent modeling of photoionization and the Kerr effect in bulk solids**, Jeremy R. Gulley, Kennesaw State Univ. (USA) [9632-32]

9:30 am: **First principles simulations of laser-induced periodic surface structure using the particle-in-cell method**, Robert A. Mitchell III, Douglass W. Schumacher, Enam Chowdhury, The Ohio State Univ. (USA) [9632-33]

9:50 am: **Calculation of nonlinear optical damage from space-time-tailored pulses in dielectrics**, Thomas E. Lanier, Jeremy R. Gulley, Kennesaw State Univ. (USA) [9632-34]

10:10 am: **The photo-ionization and band structure of solids: non-evident interplay**, Vitaly E. Gruzdev, Univ. of Missouri (United States) [9632-35]

Refreshment Break Wed 10:30 am to 11:00 am

CONFERENCE 9632

SESSION 10

Location: NIST Auditorium Wed 11:00 am to 12:40 pm

Materials and Measurements I

Session Chair: **Jérôme Néauport**,
Commissariat à l'Énergie Atomique (France)

11:00 am: **Characterization of extremely high-purity optical materials for solid state laser cooling** (*Keynote Presentation*), Mansoor Sheik-Bahae, Nathan Giannini, The Univ. of New Mexico (USA) [9632-36]

11:40 am: **Laser-induced damage of rapid-grown KDP crystals**, Yuanan Zhao, Yueliang Wang, Guohang Hu, Meiping Zhu, Weili Zhang, Xiaoyi Xie, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) [9632-37]

12:00 pm: **Laser damage of calcium fluoride by ArF excimer laser irradiation**, Minako Kashimoto, Eiichiro Nakahata, Nikon Corp. (Japan) [9632-38]

12:20 pm: **High-speed quantitative phase imaging of dynamic thermal deformation in laser irradiated films**, Lucas N. Taylor, Joseph J. Talghader, Univ. of Minnesota, Twin Cities (USA). [9632-39]

Lunch Break and NIST Tours Wed 12:40 pm to 2:30 pm

NIST FACILITY TOURS

Location: NIST Lobby Area 12:40 pm to 1:40 pm

NIST has generously offered to provide 2 limited tours of the facility, including the **NIST-F2 Atomic Clock** and the **NIST Laser Welding Lab**.

Space is limited. Sign up onsite by 2:00 pm on Tuesday to reserve your place. First come, first served for Laser Damage Attendees only. A sign-up sheet will be at the SPIE registration desk.

SESSION 11

Location: NIST Auditorium Wed 2:30 pm to 4:10 pm

Materials and Measurements II

Session Chairs: **Carmen S. Menoni**, Colorado State Univ. (USA);
Stavros G. Demos, Lawrence Livermore National Lab. (USA)

2:30 pm: **Comparative STEREO-LID (spatio-temporally resolved optical laser-induced damage) studies of critical defect distributions in IBS, ALD, and electron-beam coated dielectric films**, Yeji Xu, The Univ. of New Mexico (USA); Drew D. Schiltz, Colorado State Univ. (USA); Luke A. Emmert, The Univ. of New Mexico (USA); Andrew K. Brown, Joseph J. Talghader, Univ. of Minnesota, Twin Cities (USA); Damon E. Kletecka, Ella S. Field, John C. Bellum, Sandia National Labs. (USA); Dinesh Patel, Carmen S. Menoni, Colorado State Univ. (USA); Wolfgang Rudolph, The Univ. of New Mexico (USA) [9632-40]

2:50 pm: **Heat treatment of fused silica optics repaired by CO₂ laser**, Thomas Doualle, Laurent Gallais, Institut Fresnel (France); Philippe Cormont, Jean-Luc Rullier, Commissariat à l'Énergie Atomique (France) [9632-41]

3:10 pm: **Damage growth analysis at the National Ignition Facility**, Zhi M. Liao, Michael C. Nostrand, Pam K. Whitman, Jeffrey D. Bude, Lawrence Livermore National Lab. (USA) [9632-42]

3:30 pm: **Alternate fitting methods for sensitivity measurements of laser damage behavior**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Clemens Heese, European Space Research and Technology Ctr. (Netherlands). [9632-43]

3:50 pm: **Tunable laser source based on storage device using Bragg grating**, Chinmayee V. Prabhu Dessai, I. V. Anudeep K. Reddy, P. Saidi Reddy, G. R. C. Reddy, National Institute of Technology, Goa (India). [9632-44]

CLOSING REMARKS

Location: NIST Auditorium 4:10 pm to 4:20 pm

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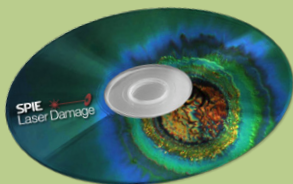
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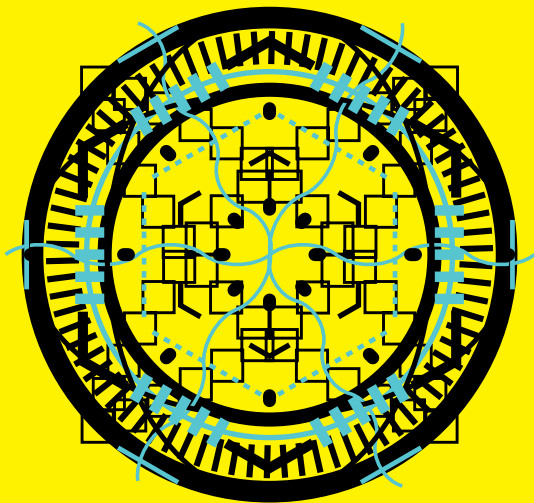
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