

# SPIE Laser Damage

Formerly Boulder Damage

41<sup>st</sup> Annual Symposium on

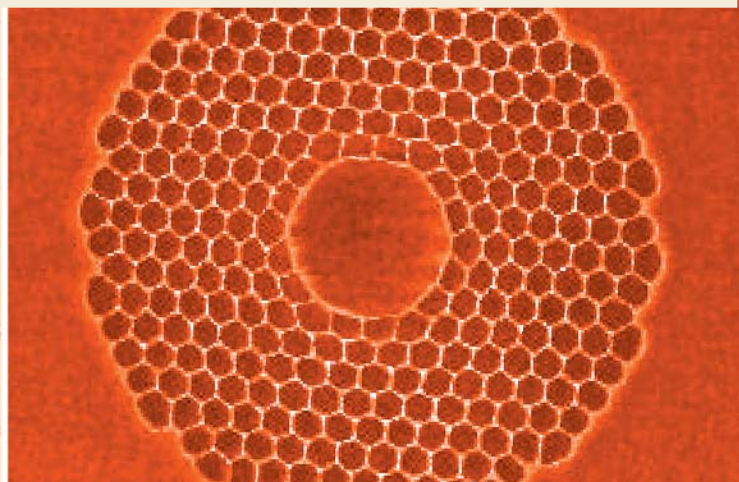
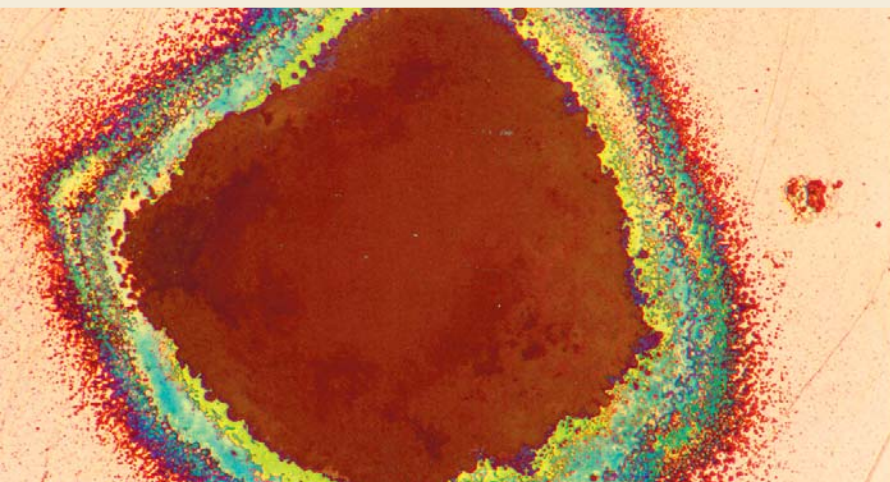
**Optical Materials for High Power Lasers**

**21–23 September 2009**

National Institute of Standards and Technology  
Boulder, Colorado, USA

Advance  
Technical  
Program

NETWORK WITH PEERS — HEAR THE LATEST RESEARCH



## ▶ Laser-Induced Damage Issues in:

- ▶ Photonic bandgap materials
- ▶ High power fiber lasers
- ▶ Fibers for high power laser applications
- ▶ High power, ultra fast, lasers
- ▶ Multi-layer thin films
- ▶ Nonlinear optical and laser host materials

## ▶ Other Laser-Induced Damage Related Issues

- ▶ Measurement protocols
- ▶ Materials characterization
- ▶ Fundamental mechanisms
- ▶ Contamination of optical components
- ▶ Surface and bulk defects

## ▶ MINI-SYMPOSIUM: Femtosecond Laser-Induced Damage



**SPIE**

Connecting minds. Advancing light.

Organizer:



Co-Sponsors:

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Cooperating Organizations:

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Electromagnetic Remote Sensing Defence  
Technology Ctr. (United Kingdom)  
School of Optics: CREOL & FPCE, College of  
Optics and Photonics, Univ. of Central Florida

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of Optics and Photonics, Univ. of Central Florida;  
Christopher J. Stolz, Lawrence Livermore National  
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Technical Contact: Kent Rochford, National Institute  
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### IMPORTANT!

You will need your registration badge to get into the  
NIST parking lot. Visitors are required to show photo  
identification upon arrival and must wear a visitor's badge  
at all times while on the NIST campus.

SPIE would like to express its deepest appreciation to the co-chairs, program  
committee, and session chairs who have so generously given of their time  
and advice to make this symposium possible. The symposium, like our other  
conferences and activities, would not be possible without the dedicated  
contributions of our participants and members.

This program is based on commitments received up to the time of publication  
and is subject to change without notice. The SPIE Event Manager for this  
symposium is Diane Cline.

Left cover photo courtesy of GJ Exarhos, PNNL Lab.  
Right photo: JD Shephard, JDC Jones, DP Hand, JC Knight, SPIE 5991, 59911Y-1 (2005).

## Conference 7504

Monday-Wednesday 21-23 September  
2009 • Proceedings of SPIE Vol. 7504

# SPIE Laser Damage

41<sup>st</sup> Annual Symposium on  
**Optical Materials for High Power Lasers**

**Sunday 20 September**

**New Special Event!**

Sun. 17.30 to 19.00 at the Boulder Marriott

**Roundtable Discussion:**

**Experimental Identification of Fundamental LID Mechanisms:  
Techniques, Challenges, and New Approaches**

Please join us on Sunday evening for an open discussion on the following  
topics:

- Critical review of the traditional criteria of LID
- Techniques to identify LID mechanisms: dependence of LID threshold  
on laser and material parameters vs. alternative approaches
- LID precursors: identification, detection, and relation to LID
- Relationship between the parametric dependences of LID threshold  
and basic LID mechanisms: How reliable and unambiguous is it?
- Alternative and future approaches to identification of the basic LID  
mechanisms

Visit our website for more information: <http://spie.org/laser-damage.xml>

### Registration Material Pick-up and Mixer

Sun. 19.00 to 21.00

The Boulder Marriott, 2660 Canyon Blvd., Boulder

### Monday 21 September

#### Registration Material Pick-up

Mon. 07.30 to 08.30

The Courtyard by Marriott Boulder, 4710 Pearl E Circle, Boulder

#### Poster Placement at NIST- Monday

Rooms 1 & 2 . . . . . Mon. 07.30 to 08.30

#### Opening Remarks

Room: Auditorium . . . . . Mon. 08.30 to 09.00

Session Chair: Vitaly E. Gruzdev, Univ. of Missouri, Columbia

#### SESSION 1

Room: Auditorium . . . . . Mon. 09.00 to 10.00

#### Thin Films I

Session Chairs: M. J. Soileau, College of Optics and Photonics, Univ. of  
Central Florida; Amy L. Rigatti, Univ. of Rochester

09.00: **Mirror characterization in the LIGO 4km interferometers** (Invited Paper),  
Rana Adhikari, California Institute of Technology (United States). . . . . [7504-01]

09.40: **Design considerations for high damage threshold UV-Vis-IR mirrors**,  
Volodymyr Pervak, Ludwig-Maximilians-Univ. München (Germany); Michael K.  
Trubetskov, Alexander V. Tikhonravov, Lomonosov Moscow State Univ. (Russian  
Federation) . . . . . [7504-02]

#### Poster Overview

Room: Auditorium . . . . . Mon. 10.00 to 10.40

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

Poster Session and Refreshment Break . . . . . 10.40 to 11.40

## Fundamental Mechanisms Posters

**Room 1 . . . . . Mon. 10.40 to 11.40**

*Posters will be displayed between 10.40 to 11.40 and 15.00 to 16.00 for viewing.*

**Influence of Na-related defects on DUV nonlinear absorption in CaF<sub>2</sub>: nanosecond versus femtosecond laser pulses**, Christian Mühlig, Herbert Stafast, Wolfgang Triebel, Thomas Zeuner, IPHT Jena (Germany) . . . . . [7504-03]

**A model for long-term laser damage in calcium fluoride**, Stephan Rix, SCHOTT AG (Germany) and Johannes Gutenberg Univ. Mainz (Germany); Martin Letz, Ute Natura, Lutz Parthier, SCHOTT AG (Germany); Claudia Felser, Johannes Gutenberg Univ. Mainz (Germany) . . . . . [7504-04]

**Laser-induced damage and non-linear absorption of ultra-short laser pulses in the bulk of fused silica**, Marco Jupé, Lars O. Jensen, Marcus Turowski, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) . . . . . [7504-05]

**The dynamic characteristic of plasma explosion in laser-induced films damage**, Zhilin Xia, Wuhan Univ. of Technology (China) . . . . . [7504-06]

**A theoretical investigation of the nonlinear optical property of four -conjugated salen compounds**, Saeed Sheykshoaeekhtiarabadi, Chalmers Univ. of Technology (Sweden) . . . . . [7504-07]

**Transient response of laser-irradiated solids studied with femtosecond short-wavelength free-electron-lasers**, Uladzimir Shymanovich, Univ. Duisburg-Essen (Germany); Anton Barty, Lawrence Livermore National Lab. (United States); Sebastien Boutet, Michael J. Bogan, SLAC National Accelerator Lab. (United States); Stefano Marchesini, Lawrence Berkeley National Lab. (United States); Nicola Stojanovic, Deutsches Elektronen-Synchrotron (Germany); Ryszard Sobierajski, Institute of Physics (Poland); W. Lu, M. El Kharrazi, M. Vattilana, F. Quirin, T. Brazda, Univ. Duisburg-Essen (Germany); Ulf Zastra, Friedrich-Schiller-Univ. Jena (Germany); Stefan Hau-Riege, Lawrence Livermore National Lab. (United States); J. Bonse, Bundesanstalt für Materialforschung und -prüfung (Germany); R. Tobey, H. Ehrke, Univ. of Oxford (United Kingdom); Andrea Cavalleri, Ctr. for Free-Electron Laser Science (Germany) and Univ. of Oxford (United Kingdom); H. Redlin, Stefan Düsterer, Deutsches Elektronen-Synchrotron (Germany); Matthias A. Frank, Lawrence Livermore National Lab. (United States); Saša Bajt, J. Schulz, Deutsches Elektronen-Synchrotron (Germany); M. Seibert, Janos Hajdu, Uppsala Univ. (Sweden); R. Treusch, Henry N. Chapman, Deutsches Elektronen-Synchrotron (Germany); Klaus Sokolowski-Tinten, Univ. Duisburg-Essen (Germany) . . . . . [7504-08]

**Characteristics of angle tuning and conversion efficiency of ZnGeP<sub>2</sub>-DFG in mid-infrared laser**, Li Wang, Beijing Univ. of Technology (China) . . . . . [7504-49]

## Thin Films Posters - Monday

**Room 2 . . . . . Mon. 10.40 to 11.40**

*Posters will be displayed between 10.40 to 11.40 and 15.00 to 16.00 for viewing.*

**Studies of femtosecond laser induced breakdown of HfO<sub>2</sub> thin film under atmospheric and vacuum environments**, Duy N. Nguyen, Luke A. Emmert, Wolfgang Rudolph, The Univ. of New Mexico (United States); Dinesh Patel, Eric Krous, Carmen S. Menoni, Colorado State Univ. (United States); Michelle D. Shinn, Thomas Jefferson National Accelerator Facility (United States) . . . . . [7504-09]

**The effect of nitrogen-doping on the multiple-pulse subpicosecond dielectric breakdown of hafnia films**, Duy N. Nguyen, Luke A. Emmert, Wolfgang Rudolph, The Univ. of New Mexico (United States); Dinesh Patel, Eric Krous, Carmen S. Menoni, Colorado State Univ. (United States) . . . . . [7504-10]

**Surface damage of thin AlN films with increased oxygen content by nanosecond and femtosecond laser pulses**, Vitaly E. Gruzdev, J. K. Chen, Univ. of Missouri, Columbia (United States); Ildar Salakhutdinov, Queens College of the City Univ. of New York (United States); Yuriy Danylyuk, Erik McCullen, Gregory W. Auner, Wayne State Univ. (United States) . . . . . [7504-11]

**Laser damage resistant features in dielectric coatings created by femtosecond laser machining**, Justin E. Wolfe, Siping R. Qiu, Christopher J. Stolz, Lawrence Livermore National Lab. (United States) . . . . . [7504-12]

**Thermal robustness of ion beam sputtered TiO<sub>2</sub>/SiO<sub>2</sub>, TiO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub> and Al<sub>2</sub>O<sub>3</sub>/SiO<sub>2</sub> IR anti-reflective coatings on YAG and sapphire substrates**, Dale C. Ness, Ove Lyngnes, Nick Traggis, Precision Photonics Corp. (United States) . . . . . [7504-13]

**Comparative study of the laser damage resistance of ZrO<sub>2</sub>-SiO<sub>2</sub> composite materials based high reflectors**, Xinbin Cheng, Tongji Univ. (China); Bin Fan, Haruo Takahashi, Optron Co., Ltd. (Japan); Jiangtao Lu, Zhanshan Wang, Tongji Univ. (China) . . . . . [7504-14]

**Optimization of scandia thin films for high power laser coating applications**, Erik M. Krous, Peter Langston, Dinesh Patel, Colorado State Univ. (United States); Ashot Markosyan, Stanford Univ. (United States); Luke A. Emmert, The Univ. of New Mexico (United States); Federico Furch, Brendan A. Reagan, Jorge J. Rocca, Colorado State Univ. (United States); Roger Route, Martin M. Fejer, Stanford Univ. (United States); Wolfgang Rudolph, The Univ. of New Mexico (United States); Michelle Shinn, Thomas Jefferson National Accelerator Facility (United States); Carmen S. Menoni, Colorado State Univ. (United States) . . . . . [7504-15]

**Laser conditioning of high reflectivity mirrors used in OPOs by 266 and 355 nm nanosecond pulses**, Arturas Vaninas, Andrius Melnikaitis, Valdas Sirtukaitis, Vilnius Univ. (Lithuania) . . . . . [7504-16]

**193 nm laser induced spectral shift in HR coated mirrors**, Byungil Cho, J. Earl Rudisill, Edward J. Danielewicz, Newport Corp. (United States) . . . . . [7504-17]

**Substrate temperature influence on the properties of ZnO thin films deposited by pulsed laser deposition**, Li Wang, Beijing Univ. of Technology (China) [7504-18]

## SESSION 2

**Room: Auditorium . . . . . Mon. 11.40 to 12.40**

### Thin Films II

*Session Chairs: M. J. Soileau, College of Optics and Photonics, Univ. of Central Florida; Amy L. Rigatti, Univ. of Rochester*

**11:40: Investigation in oxide mixture coatings with adapted gradient index profiles**, Kai Starke, Laser Zentrum Hannover e.V. (Germany) and Cutting Edge Coatings GmbH (Germany); Lars O. Jensen, Marco Jupé, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany); Giedrius Abromavicius, Institute of Physics (Lithuania) and Optida Co. Ltd. (Lithuania); Kestutis Juskevicius, Rytis Buzelis, Institute of Physics (Lithuania); Ramutis Drazdys, Institute of Physics (Lithuania) and Optida Co. Ltd. (Lithuania) . . . . . [7504-19]

**12:00: Meeting thin film design and production challenges for laser damage resistant optical coatings at the Sandia Large Optics Coating Operation**, John C. Bellum, Sandia National Labs. (United States) . . . . . [7504-20]

**12:20: Influence of subsurface defects on 355 nm laser damage resistance of monolayer and multilayer coatings**, Guohang Hu, Shuying Shao, Minghong Yang, Jianda Shao, Yuanan Zhao, Kui Yi, Zhengxiu Fan, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [7504-21]

Lunch Break . . . . . 12.40 to 14.00

## SESSION 3

**Room: Auditorium . . . . . Mon. 14.00 to 15.00**

### Thin Films III

*Session Chairs: Stavros G. Demos, Lawrence Livermore National Lab.; Semyon Papernov, Univ. of Rochester*

**14:00: Anti reflection coating damage threshold dependence on substrate material**, Ove Lyngnes, Aiko Ode, Dale C. Ness, Precision Photonics Corp. (United States) . . . . . [7504-22]

**14:20: Optical coatings with ultralow refractive index SiO<sub>2</sub> films**, Jue Wang, Corning Tropol Corp. (United States); Bin Zhou, Jun Shen, Guangming Wu, Tongji Univ. (China) . . . . . [7504-23]

**14:40: Heat and high electric insulation resistant protective coating of solar cell and thermoelectric element for offshore solar power generation**, Masataka Murahara, Tokai Univ. (Japan); Yuji Sato, Tokyo Institute of Technology (Japan); Takahisa Jitsuno, Osaka Univ. (Japan); Yoshiaki Okamoto, Okamoto Optics Co., Ltd. (Japan) . . . . . [7504-24]

Poster Session and Refreshment Break . . . . . 15.00 to 16.00

## Posters - Monday Afternoon

**Rooms 1 & 2 . . . . . Mon. 15.00 to 16.00**

### Fundamental Mechanisms and Thin Film Posters

*Posters will be displayed between 10.40 to 11.40 and 15.00 to 16.00 for viewing.*

**Please see the list of poster papers in the morning session.**

## SESSION 4

**Room: Auditorium . . . . . Mon. 16.00 to 17.40**

### Fundamental Mechanisms I

*Session Chairs: Christopher J. Stolz, Lawrence Livermore National Lab.; Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China)*

**16:00: Ultrafast laser-induced modifications of energy bands of non-metal crystals (Invited Paper)**, Vitaly E. Gruzdev, Univ. of Missouri, Columbia (United States) . . . . . [7504-27]

**16:40: Biaxial flexural strength of laser-window materials: failure-probability dependence on stressed area and surface finish**, Claude A. Klein, C.A.K. Analytics, Inc. (United States) . . . . . [7504-26]

**17:00: Light intensification by conical pits within multilayer coatings**, Siping R. Qiu, Christopher J. Stolz, Michael D. Feit, Lawrence Livermore National Lab. (United States); Thomas V. Pistor, Panoramic Technology Inc. (United States); Justin E. Wolfe, Lawrence Livermore National Lab. (United States) . . . . . [7504-28]

**17:20: Morphology of fractures, laser mitigation sites, and laser mitigation sites after wet chemical etching**, Michael D. Feit, Tayyab I. Suratwala, Lana L. Wong, William A. Steele, Jeffrey D. Bude, Lawrence Livermore National Lab. (United States) . . . . . [7504-29]

**Open House and Reception . . . . . Mon. 18.30 to 20.00**

**Alpine Research Optics**



## Tuesday 22 September

### Poster Placement at NIST - Tuesday

**Rooms 1 & 2** .....Tues. 07.30 to 08.10  
*Tuesday poster authors may set up their posters at this time.*

### SESSION 5

**Room: Auditorium** .....Tues. 08.20 to 10.00

#### Mini-Symposium: Femtosecond Laser Damage I

*Session Chairs:* **Wolfgang Rudolph**, The Univ. of New Mexico; **Leonid B. Glebov**, College of Optics and Photonics, Univ. of Central Florida

08.20: **Analysis in wavelength dependence of electronic damage**, Marco Jupé, Lars O. Jensen, Kai Starke, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany); Andrius Melninkaitis, Valdas Sirutkaitis, Vilnius Univ. (Lithuania) ..... [7504-30]

08.40: **Time-resolved digital holography: a versatile tool for femtosecond laser-induced damage studies**, Andrius Melninkaitis, Tadas Balciunas, Andrius Vanagas, Valdas Sirutkaitis, Vilnius Univ. (Lithuania) ..... [7504-31]

09.00: **Fundamental processes controlling the single and multiple femtosecond pulse damage behavior of dielectric oxide films**, Wolfgang Rudolph, The Univ. of New Mexico (United States) ..... [7504-32]

09.20: **Subpicosecond pulse laser damage behavior of dielectric thin films prepared by different techniques**, Benoit Mangote, Laurent Gallais, Mireille Commandré, Myriam Zerrad, Jean Yves Natoli, Michel Lequime, Institut Fresnel (France) ..... [7504-33]

09.40: **Damage of multilayer optics induced by intense femtosecond XUV pulses**, Ryszard Sobierajski, Institute of Physics (Poland) and FOM-Institute for Plasma Physics Rijnhuizen (Netherlands); Ali R. Khorsand, Eric Louis, Eddie D. van Hattum, Robbert W. van de Kruijs, Saskia Bruijn, FOM-Institute for Plasma Physics Rijnhuizen (Netherlands); Fred Bijkerk, FOM-Institute for Plasma Physics Rijnhuizen (Netherlands) and Univ. Twente (Netherlands); Marek Jurek, Dorota Klínger, Institute of Physics (Poland); Klaus Sokolowski-Tinten, Uladzimir Shymanovich, Univ. Duisburg-Essen (Germany); Nicola Stojanovic, Hubertus Wabnitz, Deutsches Elektronen-Synchrotron (Germany); Libor Juha, Jaromir Chalupsky, Institute of Physics of the ASCR, v.v.i. (Czech Republic); Sven Toleikis, Kai I. Tiedtke, Deutsches Elektronen-Synchrotron (Germany); Vera Hajkova, Jaroslav Cihelka, Institute of Physics of the ASCR, v.v.i. (Czech Republic) ..... [7504-34]

#### Poster Overview

**Room: Auditorium** .....Tues. 10.00 to 10.40  
*Poster authors are asked to give a 2-minute/2-viewgraph overview of their posters in the order they appear in the program.*

Poster Session and Refreshment Break ..... 10.40 to 11.40

#### Surfaces, Mirrors, and Contamination Posters

**Room 1** .....Tues. 10.40 to 11.40

**The surface layer of fused silica finished by various polishing techniques**, Yaguo Li, Zhichao Liu, Jian Wang, Qiao Xu, Chengdu Fine Optical Engineering Research Ctr. (China) ..... [7504-35]

**Diagnostics tools for subsurface damage characterization of grinded silica parts**, Philippe Cormont, Jérôme Néaupert, Nathalie Darbois, Julie Destribats, Chrystel Ambard, Olivier Rondeau, Commissariat à l'Énergie Atomique (France) .. [7504-36]

**Birefringence and residual stress induced by CO<sub>2</sub> laser mitigation of damage growth in fused silica**, Laurent Gallais, Institut Fresnel (France); Philippe Cormont, Jean-Luc Rullier, Commissariat à l'Énergie Atomique (France) ..... [7504-37]

**Thermal anneal of damage precursors on fused silica surfaces**, Nan Shen, Jeffrey D. Bude, Theodore A. Laurence, William A. Steele, Phillip E. Miller, Michael D. Feit, Lana L. Wong, Tayyab I. Suratwala, Lawrence Livermore National Lab. (United States) ..... [7504-38]

**Loss analysis of a high reflective mirror at 193 nm**, Jue Wang, Horst Schreiber, Corning Tropol Corp. (United States) ..... [7504-39]

**Accurate temperature measurement of conical cavity high-energy laser energy meter's temperature measuring system**, Wenjian Chen, Aifen Yang, Xi'an Institute of Applied Optics (China); Hui Wang, Xiaoyan Shang, Qian Li, Xi'an Technological Univ. (China) ..... [7504-40]

**Cleaning practices and facilities for the National Ignition Facility**, James A. Pryatel, William H. Gourdin, Susan C. Frieders, Lawrence Livermore National Lab. (United States) ..... [7504-41]

**Impact of outgassing organic contamination on laser induced damage of optics**, Karell Bien-Aime, Jérôme Néaupert, Isabelle Tovena-Pecault, Commissariat à l'Énergie Atomique (France); Evelyne Fargin, Univ. Bordeaux 1 (France) ..... [7504-57]

### Materials and Measurements Posters

**Room 2** .....Tues. 10.40 to 11.40

**Numerical analysis of laser-induced damage threshold search algorithms and their uncertainty**, Gintare Batavičiute, Andrius Melninkaitis, Valdas Sirutkaitis, Vilnius Univ. (Lithuania) ..... [7504-42]

**Spotsize dependence of the LIDT from the NIR to the DUV**, Lars O. Jensen, Stefan Schrameyer, Marco Jupé, Holger Blaschke, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) ..... [7504-43]

**Adaptive laser-induced damage detection**, Julius Mirauskas, Andrius Melninkaitis, Valdas Sirutkaitis, Vilnius Univ. (Lithuania) ..... [7504-44]

**Optical damage testing at the Z-Backlighter Facility of Sandia National Laboratories**, Mark Kimmel, Patrick K. Rambo, Jens Schwarz, Robin Broyles, John C. Bellum, Sandia National Labs. (United States) ..... [7504-45]

**Characterization of scattering defects structure in CaF<sub>2</sub> crystal**, Tomosumi Kamimura, Yuichi Ikeda, Tatsuya Arai, Wataru Shirai, Osaka Institute of Technology (Japan) ..... [7504-46]

**Laser-induced damage thresholds in silica glasses at different temperature**, Katsuhiro Mikami, Shinji Motokoshi, Masayuki Fujita, Takahisa Jitsuno, Junji Kawanaka, Osaka Univ. (Japan); Ryo Yasuhara, Hamamatsu Photonics K. K. (Japan) . [7504-47]

**Control of laser damage and stimulated Brillouin scattering for multimode optical fibers**, Shinji Motokoshi, Tatsuyuki Higashizawa, Takahisa Jitsuno, Osaka Univ. (Japan); Minoru Yoshida, Kinki Univ. (Japan) ..... [7504-48]

**Study of haze in 193nm high dose irradiated CaF<sub>2</sub> crystals**, Ute Natura, Stephan Rix, Martin Letz, Lutz Parthier, SCHOTT AG (Germany) ..... [7504-50]

**Characterization of CaF<sub>2</sub> optics for 193nm microlithography**, Klaus Mann, Uwe Leinhos, Bernd Schäfer, Laser-Lab. Göttingen e.V. (Germany); Masao Ariyuki, Yasuhiro Hashimoto, Naoto Mochizuki, Yoji Inui, Isao Masada, Teruhiko Nawata, Tokuyama Corp. (Japan) ..... [7504-51]

**Development of large size MgF<sub>2</sub> single crystal grown by the CZ method**, Masao Ariyuki, Yasuhiro Hashimoto, Naoto Mochizuki, Yoji Inui, Isao Masada, Teruhiko Nawata, Tokuyama Corp. (Japan); Tsuguo Fukuda, Fukuda X'tal Lab. (Japan) ..... [7504-52]

### SESSION 6

**Room: Auditorium** .....Tues. 11.40 to 12.20

#### Mini-Symposium: Femtosecond Laser Damage II

*Session Chairs:* **Wolfgang Rudolph**, The Univ. of New Mexico; **Leonid B. Glebov**, College of Optics and Photonics, Univ. of Central Florida

11.40: **Mixed metal multilayer dielectric gratings for pulse compression applications**, Jérôme Néaupert, Stephanie Palmier, Commissariat à l'Énergie Atomique (France); Nicolas Bonod, Institut Fresnel (France); Eric A. Lavastre, Nathalie Baclet, Gabriel Dupuy, Commissariat à l'Énergie Atomique (France) ..... [7504-53]

12.00: **Thin film femtosecond laser damage competition**, Christopher J. Stolz, Lawrence Livermore National Lab. (United States); Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) ..... [7504-54]

Lunch Break ..... 12.20 to 13.40

### SESSION 7

**Room: Auditorium** .....Tues. 13.40 to 15.00

#### Surfaces, Mirrors, and Contamination I

*Session Chairs:* **Jonathan W. Arenberg**, Northrop Grumman Aerospace Systems; **Michelle D. Shinn**, Thomas Jefferson National Accelerator Facility

13.40: **Aspects of laser optics qualification for space applications** (*Invited Paper*), Wolfgang Riede, Paul Allenspacher, Helmut Schröder, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Denny Wernham, European Space Research and Technology Ctr. (Netherlands) ..... [7504-55]

14.20: **The effects on glass surfaces of shrapnel and debris emissions from Petawatt laser driven solid targets**, James E. Andrew, Katie A. Wallace, Atomic Weapons Establishment (United Kingdom) ..... [7504-56]

14.40: **Chemical characterizations of optical materials: a tool for high quality components**, Chrystel Ambard, Fabien Pilon, Olivier Rondeau, Bruno Pintault, Philippe Cormont, Jérôme Néaupert, Commissariat à l'Énergie Atomique (France) . [7504-58]

Poster Session and Refreshment Break ..... Tues. 15.00 to 16.00

**Posters - Tuesday Afternoon**

**Rooms 1 & 2 . . . . . Tues. 15.00 to 16.00**

**Surfaces, Mirrors, and Contamination, and Materials and Measurements Posters**

*Posters will be displayed between 10.40 to 11.40 and 15.00 to 16.00 for viewing.*

**Please see the list of poster papers in the morning session.**

**SESSION 8**

**Room: Auditorium . . . . . Tues. 16.00 to 17.40**

**Surfaces, Mirrors, and Contamination II**

*Session Chairs: Detlev Ristau, Laser Zentrum Hannover e.V. (Germany); Jérôme Néauport, Commissariat à l'Énergie Atomique (France)*

16.00: **Identification of laser damage precursors in fused silica**, Philip E. Miller, Tayyab I. Suratwala, Jeffrey D. Bude, Joseph A. Menapace, Nan Shen, William A. Steele, Theodore A. Laurence, Michael D. Feit, Lana L. Wong, Lawrence Livermore National Lab. (United States). . . . . [7504-59]

16.20: **Residual stress and damage-induced critical fracture on CO<sub>2</sub> laser treated fused silica**, Manyalibo J. Matthews, James S. Stolken, Ryan M. Vignes, Mary A. Norton, Steven T. Yang, J. D. Cooke, Gabe Guss, John J. Adams, Lawrence Livermore National Lab. (United States). . . . . [7504-60]

16.40: **The effect of pulse duration on the growth rate of laser-induced damage sites on fused silica optics at 351 nm**, Raluca A. Negres, Mary A. Norton, Zhi M. Liao, David Cross, Jeffrey D. Bude, Christopher W. Carr, Lawrence Livermore National Lab. (United States). . . . . [7504-61]

17.00: **Study of CO<sub>2</sub> laser smoothing of surface roughness in fused silica and its effect on field intensification**, Nan Shen, Lawrence Livermore National Lab. (United States); W. D. Henshaw, J. D. Fair, Lawrence Berkeley National Lab. (United States); Gabe Guss, Isaac L. Bass, Manyalibo J. Matthews, Lawrence Livermore National Lab. (United States). . . . . [7504-62]

17.20: **Magnetorheological finishing (MRF) of potassium dihydrogen phosphate (KDP) crystals: non-aqueous fluids development, optical finish, and laser damage performance at 1064 nm and 532 nm**, Joseph A. Menapace, Paul R. Ehrmann, Robert C. Bickel, Lawrence Livermore National Lab. (United States) . . . . . [7504-63]

**NCAR Reception . . . . . Tues. 18.30 to 20.00**  
**Wine and Cheese Reception at NCAR**

**Wednesday 23 September**

**SESSION 9**

**Room: Auditorium . . . . . Wed. 08.20 to 10.40**

**Materials and Measurements I**

*Session Chairs: Vitaly E. Gruzdev, Univ. of Missouri, Columbia; James E. Andrew, Atomic Weapons Establishment (United Kingdom)*

08.20: **Nonlinear optical spectroscopy: absorption and refraction** (*Invited Paper*), Eric W. Van Stryland, David J. Hagan, Scott Webster, Lazaro A. Padilha, College of Optics and Photonics, Univ. of Central Florida (United States). [7504-64]

09.00: **Ultra-fast photoluminescence as a diagnostic for laser damage initiation**, Ted A. Laurence, Jeffrey D. Bude, Nan Shen, Phillip E. Miller, William A. Steele, Gabe Guss, John J. Adams, Lana L. Wong, Michael D. Feit, Tayyab I. Suratwala, Lawrence Livermore National Lab. (United States). . . . . [7504-65]

09.20: **Photoluminescence and photothermal deflection measurements in KDP crystals for high power applications.**, Alessandra Ciapponi, Frank R. Wagner, Jean-Yves Natoli, Institut Fresnel (France); Bertrand Bertussi, Commissariat à l'Énergie Atomique (France) . . . . . [7504-66]

09.40: **Time-resolved imaging of material cluster ejection during exit-surface damage initiation and growth in fused silica**, Stavros G. Demos, Rajesh N. Raman, Raluca A. Negres, Lawrence Livermore National Lab. (United States). . . . . [7504-67]

10.00: **High temperature thermographic measurements of laser heated silica**, Selim Elhadj, Steven T. Yang, Manyalibo J. Matthews, Ryan M. Vignes, James S. Stolken, Jeffrey D. Colvin, Jeffrey D. Bude, Lawrence Livermore National Lab. (United States). . . . . [7504-68]

10.20: **Early thermal damage in optical coatings identified by infrared spectral signatures**, Sangho S. Kim, Nicholas T. Gabriel, Wing S. Chan, Joseph J. Talghader, Univ. of Minnesota (United States) . . . . . [7504-69]  
Coffee Break . . . . . 10.40 to 11.20

**SESSION 10**

**Room: Auditorium . . . . . Wed. 11.20 to 12.40**

**Materials and Measurements II**

*Session Chairs: Vitaly E. Gruzdev, Univ. of Missouri, Columbia; James E. Andrew, Atomic Weapons Establishment (United Kingdom)*

11.20: **Process for rapid detection of light intensifying optical flaws using Line-scan Phase-differential Imaging**, Frank L. Ravizza, Michael C. Nostrand, Ruth A. Hawley, Michael A. Johnson, Lawrence Livermore National Lab. (United States) . . . . . [7504-70]

11.40: **Laser-induced surface damage density measurements of fused silica optics: a parametric study**, Laurent Lameignère, Stéphane Reyné, Thierry Donval, Roger Courchinoux, Jean-Christophe Poncetta, Bertrand Bertussi, Commissariat à l'Énergie Atomique (France) . . . . . [7504-71]

12.00: **Analysis of N on 1 tests: an initial inquiry**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (United States). . . . . [7504-72]

12.20: **Damage tests on EUV optics and sensors using focused radiation from a table-top laser-produced plasma source**, Frank Barkusky, Armin Bayer, Bernhard Flöter, Christian Peth, Klaus Mann, Laser-Lab. Göttingen e.V. (Germany). [7504-73]  
Lunch Break . . . . . 12.40 to 14.00

**SESSION 11**

**Room: Auditorium . . . . . Wed. 14.00 to 16.00**

**Materials and Measurements III**

*Session Chairs: Gregory J. Exarhos, Pacific Northwest National Lab.; Masataka Murahara, Tokai Univ. (Japan)*

14.00: **Modeling laser conditioning of KDP crystals**, Guillaume Duchateau, Commissariat à l'Énergie Atomique (France) . . . . . [7504-74]

14.20: **Laser conditioning process combining N/1 and S/1 programs to improve the damage resistance of KDP crystals**, Yuan'an Zhao, Guohang Hu, Jianda Shao, Xiaofeng Liu, Hongbo He, Zhengxiu Fan, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [7504-75]

14.40: **Nanosecond-laser induced damage at 1064nm, 532nm, and 355nm in LiB<sub>3</sub>O<sub>5</sub>**, Frank R. Wagner, Anne Hildenbrand, Jean-Yves Natoli, Mireille Commandre, Institut Fresnel (France). . . . . [7504-76]

15.00: **Laser induced damage of sapphire and titanium doped sapphire crystals under femtosecond to nanosecond laser irradiation**, Benoit Bussiere, Lasers, Plasmas et Procédés Photoniques (France) and Amplitude Technologies (France) and Institut Fresnel (France); Olivier P. Uteza, Nicolas Sanner, Marc L. Sentis, Lasers, Plasmas et Procédés Photoniques (France); Gilles Riboulet, Luc M. Vigroux, Amplitude Technologies (France); Mireille Commandre, Franck Wagner, Jean-Yves Natoli, Institut Fresnel (France); Jean-Paul Chambaret, Ecole Nationale Supérieure de Techniques Avancées (France) . . . . . [7504-77]

15.20: **Deterministic single-shot and multiple-shot bulk damage thresholds for doped and undoped, crystalline, and ceramic YAG**, Binh Trong Do, Sandia National Labs. (United States); Arlee V. Smith, AS-Photonics, LLC (United States) . . . . . [7504-78]

15.40: **Zinc oxide nanostructures synthesized by pulsed laser ablation in methanol**, Subhash C. Singh, Univ. of Allahabad (India) . . . . . [7504-79]

**Closing Remarks . . . . . Wed. 16.00 to 16.10**

**Open House . . . . . Wed. 16.30 to 18.00**  
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paper 7132-41

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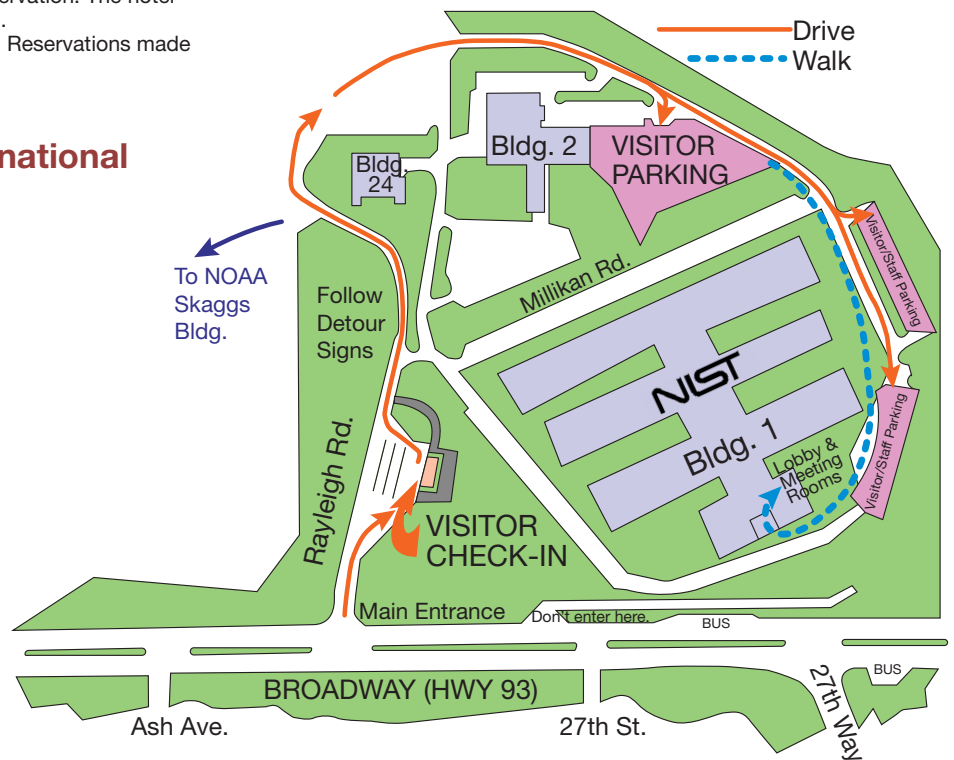
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