

# SPIE Laser Damage

XLII Annual Symposium on  
**Optical Materials for High Power Lasers**

Connecting minds for global solutions  
The leading forum for high-power/high-energy lasers

## Technical Program

26–29 September 2010  
National Institute of Standards and Technology  
Boulder, Colorado, USA

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# Conference 7842

Sunday-Wednesday 26-29 September 2010  
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## **SPIE** Laser Damage

XLII Annual Symposium on

### **Optical Materials for High Power Lasers**

*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)  
**M. J. Soileau**, Univ. of Central Florida (USA)

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**Mireille Commandré**, Institut Fresnel (France)  
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**Klaus Mann**, Laser-Lab. Göttingen e.V. (Germany)  
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**Masataka Murahara**, Tokai Univ. (Japan)  
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**Jianda Shao**, Shanghai Institute of Optics and Fine Mechanics (China)  
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*Founding Organizers:*

**Arthur H. Guenther** and **Alexander J. Glass**

*Organizer:*



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**National Institute of Standards and Technology**  
**CREOL & FPCE, College of Optics and Photonics,**  
**University of Central Florida**  
**University of Missouri-Columbia**

*Technical Contact:*

**Kent Rochford**, National Institute of Standards and Technology (USA)

# Sunday 26 September

## Sunday Events

Boulder Marriott, 2660 Canyon Blvd., Boulder

### REGISTRATION MATERIAL PICK-UP

**Room: Montrachet Room (1<sup>st</sup> floor)**

**Sun. 17.00 to 20.30**

### ROUND TABLE DISCUSSION

**Boulder Marriott, Montrachet Room (1<sup>st</sup> floor)**

**Sun. 17.30 to 19.00**

### **Multiphoton Ionization vs. Avalanche (Impact) Ionization in LID of Transparent Optical Materials**

This year the Round Table focuses on a specific topic related to fundamentals of LID: relation between multiphoton and avalanche (impact) ionization in initiating LID in transparent optical materials. The standard (and the most frequently employed) approach considers overall generation of conduction-band electrons by laser radiation as a result of combined action of the two ionization mechanisms. Among them, the multiphoton ionization is frequently assumed to be a starter of the impact ionization by providing seed conduction-band electrons for development of the electron avalanche. The avalanche is believed to dominate due to its extremely high rate. Experimental data have already demonstrated that this approach fails to explain some scaling of LID threshold with laser frequency even for nanosecond pulses. Meanwhile, this approach has been spread to the case of ultra-short (femtosecond) laser pulses. The aim of this discussion is to clarify relation between those ionization mechanisms to the maximum possible degree according to the current level of our understanding of laser-induced ionization.

### SOCIAL MIXER

**Room: Montrachet Room (1<sup>st</sup> floor)**

**Sun. 19.00 to 21.00**

Registration Material Pick-up continues until 20.30.

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*SPIE would like to express its deepest appreciation to the co-chairs, international program committee, session chairs, and authors 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.*

# Monday 27 September

## CONFERENCE LOCATION:

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

### REGISTRATION MATERIAL PICK-UP

**NIST Lobby Area . . . . . Mon. 07.30 to 08.30**

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

### POSTER PLACEMENT AT NIST

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

### OPENING REMARKS

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

**Joseph A. Menapace,**  
Lawrence Livermore National Lab.

### SESSION 1

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

#### Thin Films I

*Session Chairs:* **Vitaly E. Gruzdev,**  
Univ. of Missouri-Columbia (United States);  
**Gregory J. Exarhos,** Pacific Northwest National  
Lab. (United States)

09.00: **Advances in ion beam sputtered optical interference coatings** (*Invited Paper*), Carmen S. Menoni, Colorado State Univ. (United States). . . . . [7842-01]

09.40: **Complex study of zirconia-silica and niobia-silica composite coatings produced by ion beam sputtering,** Andrius Melninkaitis, Julius Mirauskas, Maksim Jeskevich, Lina Žitkute, Valdas Sirutkaitis, Vilnius Univ. (Lithuania); Xinghai Fu, Benoit Mangote, Myriam Zerrad, Laurent Gallais, Mireille Commandre, Institut Fresnel (France); Tomas Tolenis, Simonas Kicas, Ramutis Drazdys, Institute of Physics (Lithuania) . . . [7842-02]

## MONDAY 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

## POSTERS—MONDAY

**Rooms: 1 & 2. . . . . Mon. 10.40 to 11.40**

### Fundamental Mechanisms

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

**Femtosecond laser damage and ablation of dielectrics: determinism, selectivity and nanometric resolution**, Nicolas Sanner, Olivier P. Uteza, Benoit Chimier, Arnaud Brocas, Nadezda Varkentina, Marc L. Sentis, Lasers, Plasmas et Procédés Photoniques (France); Philippe Lassonde, François Légaré, Jean-Claude Kieffer, Institut National de la Recherche Scientifique (Canada) . . . . . [7842-03]

**Temperature dependence of nonlinear optical phenomena in silica glasses**, Katsuhiro Mikami, Shinji Motokoshi, Masayuki Fujita, Takahisa Jitsuno, Masakatsu Murakami, Osaka Univ. (Japan) . . . . . [7842-04]

**3D morphology of laser-induced bulk damage in KDP crystal with different orientations**, Guohang Hu, Hongji Qi, Hongbo He, Dawei Li, Yuanan Zhao, Jianda Shao, Zhengxiu Fan, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [7842-05]

**Calculation and measurement of fs-LIDT of  $T_xSi_{1-x}O_2$  mixtures**, Marco Jupé, Lars O. Jensen, Mathias Mende, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany); Luke A. Emmert, Wolfgang Rudolph, Duy Nguyen, The Univ. of New Mexico (United States); Andrius Melninkaitis, Valdas Sirutkaitis, Vilnius Univ. (Lithuania) . . . . . [7842-06]

**KDP crystal orientation influence on the nanosecond laser-induced damage at 1064 nm**, Stéphane Reyné, Guillaume Duchateau, Commissariat à l'Énergie Atomique (France); Jean-Yves Natoli, Institut Fresnel (France); Laurent Lamaignère, Commissariat à l'Énergie Atomique (France) . . . . . [7842-07]

**Femtosecond pulse S on 1 LIDT in dielectric materials: comparison of experiment and theory**, Luke A. Emmert, Mark Mero, Duy N. Nguyen, Wolfgang Rudolph, The Univ. of New Mexico (United States); Dinesh Patel, Erik M. Krous, Carmen S. Menoni, Colorado State Univ. (United States) . . . . . [7842-08]

**Detonation regimes of optical discharge propagation in silica-based optical fibers**, Vladimir E. Fortov, Vladimir P. Efremov, Institute for High Energy Densities (Russian Federation); Eugeny M. Dianov, Igor A. Bufetov, Artem A. Frolov, A.M. Prokhorov General Physics Institute (Russian Federation) . . . . . [7842-09]

**Extreme nonlinear optics and laser damage, Evaldas K. Maldutis**, The General Jonas Zemaitis Military Academy of Lithuania (Lithuania) . . . . . [7842-87]

## POSTERS—MONDAY CONTINUED

Rooms: 1 & 2. . . . . Mon. 10.40 to 11.40

### Thin Films

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

**Laser-induced damage threshold of 266 AR coatings with different coating designs**, Byungil Cho, Edward J. Danielewicz, J. Earl Rudisill, Newport Corp. (United States) . . . . . [7842-10]

**Laser damage resistance of dichroic mirrors at 532nm and 1064nm**, Xinbin Cheng, Tao Ding, Zhengxiang Shen, Hongfei Jiao, Jinlong Zhang, Bin Ma, Zhanshan Wang, Tongji Univ. (China) . . . . . [7842-11]

**Effects of electric field distribution and pulse durations on the ultra-short pulse laser damage resistance of laser coatings**, Shunli Chen, Meiping Zhu, Dawei Li, Hongbo He, Yuanan Zhao, Jianda Shao, Zhengxiu Fan, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [7842-12]

**LIDT of HfO<sub>2</sub>/SiO<sub>2</sub> HR films by different test modes at 1064nm and 532nm**, Bin Ma, Tao Ding, Hongfei Jiao, Gang Zhou, Zhengxiang Shen, Xinbin Cheng, Jinlong Zhang, Tongji Univ. (China); Huasong Liu, Yiqin Ji, Tianjin Jinhang Institute of Technical Physics (China); Pengfei He, Zhanshan Wang, Tongji Univ. (China) . [7842-13]

**Database on laser-induced damage thresholds for AR and HR coatings in Japan**, Shinji Motokoshi, Katsuhiro Mikami, Takahisa Jitsuno, Kota Kato, Osaka Univ. (Japan) . . . . . [7842-14]

**Influence of cleanliness on weak absorption and laser-induced damage of HR coatings at 1064 nm**, Zhengxiang Shen, Tao Ding, Xiaodong Wang, Xiaowen Ye, Bin Ma, Xinbin Cheng, Tongji Univ. (China); Huasong Liu, Yiqin Ji, Tianjin Jinhang Institute of Technical Physics (China); Zhanshan Wang, Tongji Univ. (China) . . . [7842-15]

**Optical properties and LIDT of AR coatings on LBO crystals**, Rytis Buzelis, Institute of Physics (Lithuania); Giedrius Abromavicius, Institute of Physics (Lithuania) and Optida Co., Ltd. (Lithuania); Ramutis Drazdys, Kestutis Juskevicius, Simonas Kicas, Institute of Physics (Lithuania); Kai Starke, Wjatscheslaw Sakiew, Lars O. Jensen, Marco Jupé, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) . . . . . [7842-16]

**Exposure of high-reflecting fluoride coatings under high fluence conditions at 193nm**, Holger Blaschke, Laser Zentrum Hannover e.V. (Germany); Werner Riggers, Laseroptik GmbH (Germany); Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) . . . . . [7842-17]

**N on 1 testing of AR and HR designs at 1064 and 355 nm**, Wolfgang Riede, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Jon H. Herringer, Arrow Thin Films, Inc. (United States); Paul Allenspacher, Alessandra Ciapponi, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Jon W. Arenberg, Northrop Grumman Aerospace Systems (United States) . . . . . [7842-18]

**Investigation of laser damage in single layer coatings with pulse durations from 45fs to 24ps**, Benoit Mangote, Laurent Gallais, Institut Fresnel (France); Andrius Melninkaitis, Julius Mirauskas, Vilnius Univ. (Lithuania); Myriam Zerrad, Institut Fresnel (France); Maksim Jeskevic, Valdas Sirutkaitis, Vilnius Univ. (Lithuania); Mireille Commandré, Institut Fresnel (France) . . . . . [7842-19]

**Stress compensation in HfO<sub>2</sub>/SiO<sub>2</sub> multilayer by ion assisted electron beam evaporation**, Tao Ding, Hongfei Jiao, Bin Ma, Jinlong Zhang, Zhengxiang Shen, Xinbin Cheng, Zhanshan Wang, Tongji Univ. (China) . . . . . [7842-20]

## SESSION 2

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

### Thin Films II

*Session Chairs:* **Vitaly E. Gruzdev**,  
Univ. of Missouri-Columbi (United States) ;  
**Gregory J. Exarhos**, Pacific Northwest National  
Lab. (United States)

- 11.40: **Evaluation of inclusion sources in e-beam evaporated hafnia/silica coatings**, Justin E. Wolfe, Siping R. Qiu, Christopher J. Stolz, Lawrence Livermore National Lab. (United States); Amy L. Rigatti, James B. Oliver, Univ. of Rochester (United States) .....[7842-21]
- 12.00: **Study of laser-induced damage of high reflector at 1064nm**, Hongfei Jiao, Tao Ding, Xinbin Cheng, Bin Ma, Jinlong Zhang, Zhengxiang Shen, Pengfei He, Zhanshan Wang, Tongji Univ. (China) .....[7842-22]
- 12.20: **BDS thin film UV antireflection laser damage competition**, Christopher J. Stolz, Lawrence Livermore National Lab. (United States); Michael D. Thomas, Andrew J. Griffin, Spica Technologies, Inc. (United States) .....[7842-23]
- Lunch Break .....12.40 to 13.40

## SESSION 3

Room: Auditorium.....Mon. 13.40 to 15.00

### Thin Films III

*Session Chairs:* **Jonathan W. Arenberg**, Northrop  
Grumman Aerospace Systems (United States);  
**Jérôme Néauport**, Commissariat à l'Énergie Atomique (France)

- 13.40: **Investigations on SiO<sub>2</sub>/HfO<sub>2</sub> mixtures for nanosecond and femtosecond pulses**, Lars O. Jensen, Mathias Mende, Holger Blaschke, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany); Duy Nguyen, Luke A. Emmert, Wolfgang Rudolph, The Univ. of New Mexico (United States) .....[7842-24]
- 14.00: **Laser damage by ns and sub-ps pulses on hafnia/silica anti-reflection coatings on fused silica double-sided polished using zirconia or ceria and washed with or without an alumina wash step**, John C. Bellum, Damon Kletecka, Mark Kimmel, Patrick Rambo, Ian Smith, Jens Schwarz, Briggs Atherton, Sandia National Labs. (United States); Zachary Hobbs, Sydor Optics, Inc. (United States) .....[7842-25]
- 14.20: **Mixed metal dielectric pulse compression gratings**, Jérôme Néauport, Stéphanie Palmier, Commissariat à l'Énergie Atomique (France); Nicolas Bonod, Institut Fresnel (France) [7842-75]
- 14.40: **Submicrometer-resolution mapping of ultraweak 355nm absorption in HfO<sub>2</sub> monolayers using photothermal heterodyne imaging**, Semyon Papernov, Univ. of Rochester (United States); Alex Tait, Princeton Univ. (United States); Wade Bittle, Ansgar W. Schmid, James B. Oliver, Peter T. Kupinski, Univ. of Rochester (United States) .....[7842-27]
- 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 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 18.00

### Fundamental Mechanisms I

Session Chairs: **Jonathan W. Arenberg**, Northrop Grumman Aerospace Systems (United States);

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

16.00: **Imaging the early material response associated with exit surface damage in fused silica** (*Invited Paper*), Stavros G. Demos, Raluca A. Negres, Rajesh N. Raman, Lawrence Livermore National Lab. (United States). . . . . [7842-28]

16.40: **Temperature activated absorption during laser-induced damage**, Christopher W. Carr, Jeffrey D. Bude, Lawrence Livermore National Lab. (United States). . . . . [7842-29]

17.00: **Morphological changes induced by CO<sub>2</sub> laser-based damage mitigation of SiO<sub>2</sub> surfaces**, Michael D. Feit, Ibo J. Matthews, Thomas F. Soules, James S. Stolken, Ryan M. Vignes, Steven T. Yang, Diane J. Cooke, Lawrence Livermore National Lab. (United States). . . . . [7842-30]

17.20: **Molecular dynamics study of silica glass during laser heating/cooling**, Thomas F. Soules, George H. Gilmer, Manyalibo J. Matthews, James S. Stolken, Lawrence Livermore National Lab. (United States). . . . . [7842-31]

17.40: **Tridimensionnal multiphysical model for the study of photo-induced thermal effects in laser damage phenomena**, Mireille Commandré, Guillaume Demesy, Laurent Gallais, Institut Fresnel (France). . . . . [7842-32]

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



**Saint-Gobain Crystals**

6810 Winchester Circle, Boulder



# Tuesday 28 September

## POSTER PLACEMENT AT NIST

**Rooms: 1 & 2 ..... Tues. 07.30 to 08.20**

*Tuesday poster authors may set up their posters at this time.*

## SESSION 5

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

### Fundamental Mechanisms II

*Session Chairs:* **M. J. Soileau**, Univ. of Central Florida (United States); **Detlev Ristau**, Laser Zentrum Hannover e.V. (Germany)

**08.20: Characterisation of contaminant plumes arising from laser solid target interactions**, James E. Andrew, Katherine A. Wallace, AWE plc (United Kingdom) .....[7842-33]

**08.40: Modeling of laser-induced damage in KDP crystals by nanosecond pulses: a hydrodynamic study**, Guillaume Duchateau, Commissariat à l'Énergie Atomique (France); Ludovic Hallo, Univ. Bordeaux 1 (France) .....[7842-34]

**09.00: Identification of the laser-induced damage mechanisms in KDP by coupling 355nm and 1064nm nanosecond pulses**, Stéphane Reyné, Guillaume Duchateau, Commissariat à l'Énergie Atomique (France); Jean-Yves Natoli, Institut Fresnel (France); Laurent Lamaignère, Commissariat à l'Énergie Atomique (France) .....[7842-35]

**09.20: Frequency dependence in the initiation of ultrafast laser-induced damage**, Jeremy R. Gulley, Kennesaw State Univ. (United States) .....[7842-36]

**09.40: The 'vacuum effect' of femtosecond LIDT measurements on dielectric films**, Duy N. Nguyen, Luke A. Emmert, Wolfgang Rudolph, The Univ. of New Mexico (United States); Dinesh Patel, Erik M. Krous, Carmen S. Menoni, Colorado State Univ. (United States) .....[7842-37]

## TUESDAY 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

## POSTERS–TUESDAY

**Rooms: 1 & 2. . . . . Tues. 10.40 to 11.40**

### Surfaces, Mirrors, and Contamination

**Damage phenomenon of large-aperture fused silica grating**, Wei Han, Fuquan Li, Chinese Academy of Engineering Physics (China) . . . . . [7842-38]

**Inhibition of contamination laser induced damage to optical substrates**, Bruce H. Weiller, Jesse D. Fowler, Randy M. Villahermosa, The Aerospace Corp. (United States) . . . . . [7842-39]

**Effects of characteristic parameters of subsurface defect on anti-damage capability of fused silica**, Jin Huang, Chinese Academy of Engineering Physics (China) . . . . . [7842-40]

**Femtosecond laser microfabrication by axicon lens**, Hao Zhang, Jaap I. Dijkhuis, Utrecht Univ. (Netherlands) . . . . . [7842-41]

**The effect of CO<sub>2</sub> laser annealing on residual stress and on the laser damage resistance for fused silica optics**, Philippe Cormont, Commissariat à l'Énergie Atomique (France); Laurent Gallais, Institut Fresnel (France); Laurent Lamaignère, Thierry Donval, Jean-Luc Rullier, Commissariat à l'Énergie Atomique (France) . . . . . [7842-42]

**Investigation of scratch and pits for large polished mirror surface**, Etsuo Fujiwara, Nozomu Araki, Univ. of Hyogo (Japan) . . . . . [7842-43]

**Long-term laser induced contamination tests of optical elements under vacuum at 351nm**, Uwe Leinhos, Klaus Mann, Armin Bayer, Jens-Oliver Dette, Matthias Schöneck, Laser-Lab. Göttingen e.V. (Germany); Martin Endemann, Denny Wernham, Federico Petazzi, Adrian P. Tighe, Jorge Alves, European Space Research and Technology Ctr. (Netherlands); Dominique Thibault, EADS Astrium (France) . . . . . [7842-44]

### Materials and Measurements

**Explanation of laser-induced damage behavior of fused silica in a large-aperture laser using a small-aperture damage test**, Fuquan Li, Wei Han, Chinese Academy of Engineering Physics (China) . . . . . [7842-45]

**Studies on the emission and Electron Spin Resonance spectroscopic properties of microstructures in polymer films achieved using femtosecond laser direct writing**, Lakshmi Narayana D. Kallepalli, Venugopal R. Soma, Kuladeep Rajamudili, Praveen K. Velpula, Narayana R. Desai, Univ. of Hyderabad (India) . . . . . [7842-46]

**Positron lifetime and coincidence Doppler broadening study of vacancy-type defects in fused silica induced by ultraviolet laser pulses**, Chunhong Li, Univ. of Science and Technology Beijing (China); Jin Huang, Xinda Zhou, Xiaodong Jiang, Weidong Wu, Chinese Academy of Engineering Physics (China); Zhuoxin Li, Baoyi Wang, Institute of High Energy Physics (China); Xin Ju, Univ. of Science and Technology Beijing (China) . . . . . [7842-47]

- Characterization of fiber preforms for high power lasers using LID absorption measurement technique**, Christian Mühlig, Simon Bublitz, Stephan Grimm, IPHT Jena (Germany); Andreas Langner, Gerhard Schötz, Heraeus Quarzglas GmbH & Co. KG (Germany) . . . . . [7842-48]
- Piezoelectric resonance spectroscopy of laser induced damage in nonlinear-optical crystals**, Aleksei V. Konyashkin, Daniil V. Myasnikov, Institute of Radio Engineering and Electronics (Russian Federation) and Moscow Institute of Physics and Technology (Russian Federation); Valentin A. Tyrtshnyy, Moscow Institute of Physics and Technology (Russian Federation); Aleksei V. Doronkin, Oleg A. Ryabushkin, Institute of Radio Engineering and Electronics (Russian Federation) and Moscow Institute of Physics and Technology (Russian Federation) . . . . . [7842-49]
- Dual wavelength laser damage testing for high energy lasers**, Mark Kimmel, Patrick K. Rambo, Jens Schwarz, John C. Bellum, Briggs W. Atherton, Sandia National Labs. (United States) . [7842-50]
- Development of free designable ceramic fiber and its laser property**, Tomosumi Kamimura, Osaka Institute of Technology (Japan); Takayuki Okamoto, Okamoto Optics Co., Ltd. (Japan); Yan Lin Aung, Akio Ikesue, World Lab Co., Ltd. (Japan) . . . . . [7842-51]
- Influence of ion implantation on damage threshold and optical properties of thin metal films on lithium niobate used as photodetector of high-power laser radiation**, Viktor O. Lysiuk, V. Lashkaryov Institute of Semiconductor Physics (Ukraine); Vasyl S. Staschuk, National Taras Shevchenko Univ. of Kyiv (Ukraine); Mykola I. Kluy, V. Lashkaryov Institute of Semiconductor Physics (Ukraine) . . . . . [7842-52]
- Population kinetics of the fluorescing M center state in CaF<sub>2</sub> upon fs laser excitation at 392 nm and 262 nm**, Christian Karras, Christian Muehlig, Herbert Stafast, Wolfgang Triebel, Thomas Zeuner, Wolfgang Paa, IPHT Jena (Germany) . . . . . [7842-53]
- Linear and nonlinear absorption of Ti<sub>x</sub>Si<sub>1-x</sub>O<sub>2</sub> mixtures**, Marco Jupé, Laser Zentrum Hannover e.V. (Germany); Kai Starke, Cutting Edge Coatings GmbH (Germany); Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) . . . . . [7842-54]
- Effects of thermal annealing on KDP and DKDP on laser damage resistance at 3w**, François P. Guillet, Bertrand Bertussi, Laurent Lamaignère, Cédric Maunier, Commissariat à l'Énergie Atomique (France) . . . . . [7842-55]
- Study of relation between crystallinity and laser damage of calcium fluoride**, Minako Azumi, Eiichiro Nakahata, Nikon Corp. (Japan) . . . . . [7842-56]
- The image processing for single-shot measurement of laser damage threshold**, Jianping Hu, Zhichao Liu, Songlin Chen, Ping Ma, Qiao Xu, Chengdu Fine Optical Engineering Research Ctr. (China) . . . . . [7842-57]

## SESSION 6

Room: Auditorium. . . . . Tues. 11.40 to 13.00

### MINI-SYMPOSIUM: Fundamentals of Laser Ablation

Session Chair: **Klaus Sokolowski-Tinten**,  
Univ. Duisburg-Essen (Germany)

11.30: **Insight from molecular dynamics simulation into ultrashort-pulse laser ablation** (*Invited Paper*), Herbert M. Urbassek, Technische Univ. Kaiserslautern (Germany) . . . .[7842-58]

12.10: **Short-pulse laser induced melting and ablation studied with time-resolved coherent XUV scattering**, Klaus Sokolowski-Tinten, Univ. Duisburg-Essen (Germany); Anton Barty, Deutsches Elektronen-Synchrotron (Germany); Sebastien Boutet, SLAC National Accelerator Lab. (United States); Uladzimir Shymanovich, Univ. Duisburg-Essen (Germany); Henry N. Chapman, Deutsches Elektronen-Synchrotron (Germany); Michael J. Bogan, SLAC National Accelerator Lab. (United States); Stefano Marchesini, Lawrence Berkeley National Lab. (United States); Stefan Hau-Riege, Lawrence Livermore National Lab. (United States); Nikola Stojanovic, Deutsches Elektronen-Synchrotron (Germany); Jörn Bonse, Bundesanstalt für Materialforschung und -prüfung (Germany); Yudi Rosandi, Herbert M. Urbassek, Technische Univ. Kaiserslautern (Germany); Raanan I. Tobey, Henri Ehrke, Univ. of Oxford (United Kingdom); Andrea Cavalleri, Stefan Dusterer, Harald Redlin, Deutsches Elektronen-Synchrotron (Germany); Mathias A. Frank, Lawrence Livermore National Lab. (United States); Sasa Bajt, Joachim Schulz, Deutsches Elektronen-Synchrotron (Germany); Marvin Seibert, Janos Hajdu, Uppsala Univ. (Sweden); Rolf Treusch, Deutsches Elektronen-Synchrotron (Germany); Christoph Bostedt, SLAC National Accelerator Lab. (United States); Mathias Hoener, Lawrence Berkeley National Lab. (United States); Thomas Moeller, Technische Univ. Berlin (Germany) . . . . .[7842-59]

12.30: **Modeling of laser-induced ionization of solid dielectrics for ablation simulations: role of effective mass**, Vitaly E. Gruzdev, Univ. of Missouri-Columbia (United States) . . . . .[7842-60]

Lunch Break . . . . . 13.00 to 14.00

## SESSION 7

Room: Auditorium. . . . . Tues. 14.00 to 15.00

### Materials and Measurements I

Session Chairs: **Michelle Shin**, Thomas Jefferson National Accelerator Facility (United States); **Detlev Ristau**, Laser Zentrum Hannover e.V. (Germany)

14.00: **Multiscale analysis: a way to investigate laser damage precursors in materials for high power applications at nanosecond pulse duration** (*Invited Paper*), Jean-Yves Natoli, Institut Fresnel (France) . . . . .[7842-61]

14.40: **Determination of laser damage initiation probability and growth on fused silica scratches**, Mary A. Norton, Christopher W. Carr, David Cross, Raluca A. Negres, Jeffrey D. Bude, William A. Steele, Lawrence Livermore National Lab. (United States) . .[7842-62]

Poster Session and Refreshment Break . . . . . 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 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 18.00**

### **Materials and Measurements II**

*Session Chairs: Michelle Shin, Thomas Jefferson National  
Accelerator Facility (United States);*

**James E. Andrew, AWE plc (United Kingdom)**

**16.00: Comparing the use of mid-infrared versus far-infrared lasers for mitigating damage growth on fused silica**, Steven T. Yang, Manyalibo J. Matthews, Selim Elhadj, Diane J. Cooke, Gabriel M. Guss, Vaughn G. Draggoo, Paul J. Wegner, Lawrence Livermore National Lab. (United States). . . . . [7842-63]

**16.20: Impact of the Laser Chemical Processing (LCP) on crystal damage and minority carrier lifetime in silicon solar cells**, Filip Granek, Sybille Hopman, Paul Gundel, Fraunhofer-Institut für Solare Energiesysteme (Germany) . . . . . [7842-64]

**16.40: An empirical investigation of the laser survivability curve**, Jonathan W. Arenberg, Northrop Grumman Corp. (United States); Wolfgang Riede, Paul Allenspacher, Alessandra Ciapponi, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Jon H. Herringer, Arrow Thin Films, Inc. (United States). . . . . [7842-65]

**17.00: Programmable defect blocking system for mitigating laser-induced damage growth on the National Ignition Facility**, John E. Heebner, Michael R. Borden, Philip E. Miller, Christopher J. Stolz, Tayyab I. Suratwala, Paul J. Wegner, Mark R. Hermann, Mark A. Henesian, Christopher A. Haynam, Steve Hunter, Kim S. Christensen, Nan Wong, Lynn G. Seppala, Gordon Brunton, Eddy Tse, Abdul A. Awwal, Mark Franks, Ed Marley, Kevin Williams, Michael F. Scanlan, Lawrence Livermore National Lab. (United States) . . . . . [7842-66]

**17.20: Use of machine learning algorithms and data mining techniques to identify and remove noisy data**, Ghaleb M. Abdulla, Laura M. Kegelmeyer, Zhi M. Liao, Christopher W. Carr, Lawrence Livermore National Lab. (United States) . . . . . [7842-68]

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

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# Wednesday 29 September

## SESSION 9

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

### Materials and Measurements III

*Session Chairs:* **Stavros G. Demos**, Lawrence Livermore National Lab. (United States); **Jianda Shao**, Shanghai Institute of Optics and Fine Mechanics (China)

08.20: **Risk mitigation for laser-induced contamination on the ADM-Aeolus satellite**, Denny Wernham, Federico Pettazzi, Jorge Alves, Adrian P. Tighe, European Space Research and Technology Ctr. (Netherlands) . . . . . [7842-69]

08.40: **HEL-generated extinction effects and extinction along extended atmospheric paths: implications for USAF-ABL and HEL-missile exhaust plumes interactions**, Clifford A. Paiva, BSM Research Associates (United States) . . . . . [7842-70]

09.00: **High-intensity fibre laser design for micro-machining applications**, David I. Ortiz-Neria, Fernando Martinez-Pinon, Jose A. Alvarez-Chavez, Ctr. de Investigación e Innovación Tecnológica (Mexico). . . . . [7842-71]

09.20: **Improvement of laser damage resistance and diffraction efficiency of multilayer dielectric diffraction gratings by HF-etchback linewidth tailoring**, Hoang T. Nguyen, Cindy C. Lasron, Jerald A. Britten, Lawrence Livermore National Lab. (United States) . . . . . [7842-72]

09.40: **Mode-selection in novel high-intensity Yb<sup>3+</sup>-doped fiber laser cavities**, Jose A. Alvarez-Chavez, Solange I. Rivera-Manrique, Fernando Martinez-Piñon, Ctr. de Investigación e Innovación Tecnológica (Mexico); Herman L. Offerhaus, Univ. Twente (Netherlands) . . . . . [7842-73]

Coffee Break . . . . . 10.00 to 10.30

## SESSION 10

**Room: Auditorium. . . . . Wed. 10.30 to 12.30**

### Surfaces, Mirrors, and Contamination I

*Session Chairs:* **Carmen S. Menoni**, Colorado State Univ. (United States); **Mireille Commandré**, Institut Fresnel (France)

10.30: **Developing MRF technology for the manufacture of large-aperture optics in mega-joule class laser systems** (*Invited Paper*), Joseph A. Menapace, Lawrence Livermore National Lab. (United States) . . . . . [7842-74]

11.10: **Impact of substrate surface scratches on laser damage resistance of multilayer coatings**, Siping R. Qiu, Justin E. Wolfe, Anthony M. Monterrosa, Nick E. Teslich, Michael D. Feit, Thomas V. Pistor, Christopher J. Stolz, Lawrence Livermore National Lab. (United States). . . . . [7842-26]

11.30: **Damage testing of critical optical components for high power ultra fast lasers**, Enam Chowdhury, Brittany Taylor, Rebecca Daskalova, Patrick Poole, Linn D. Van Woerkom, Richard Freeman, The Ohio State Univ. (United States); Douglas J. Smith, Plymouth Grating Lab. (United States) . . . . . [7842-76]

11.50: **Damage threshold measurements of AR microstructures, and microstructure-based high reflectors and polarizers in the near UV**, Douglas S. Hobbs, Curtis A. Lockshin, Bruce D. MacLeod, TelAztec LLC (United States) . . . . .[7842-77]

12.10: **An improved method of mitigating laser-induced surface damage growth in fused silica using a rastered, pulsed CO<sub>2</sub> laser**, Isaac L. Bass, Gabriel M. Guss, Michael C. Nostrand, Paul J. Wegner, Lawrence Livermore National Lab. (United States) . . . . .[7842-78]

Lunch Break . . . . .12.30 to 14.00

**NEW EVENT**

**NIST Facility Tour . . . . . Wed. 13.15 to 14.00**

NIST has generously offered to provide limited tours of the facility, including the NIST-F1 and NIST-F2 Atomic Clocks. Space is limited. Sign-up onsite to reserve your place. First come, first served for Laser Damage attendees only. A sign-up sheet will be at the registration desk.

**SESSION 11**

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

**Surfaces, Mirrors, and Contamination II**

*Session Chairs:* **Leonid B. Glebov**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States); **Masataka Murahara**, Tokai Univ. (Japan)

14.00: **Oil-contamination problem in large-scale pulse-compressor**, Takahisa Jitsuno, Hidetosi Murakami, Shinji Motokoshi, Eiji Sato, Katsuhiro Mikami, Kota Kato, Tetsuji Kawasaki, Yoshiki Nakata, Nobuhiko Sarukura, Toshihiko Shimizu, Hiroyuki Shiraga, Noriaki Miyana, Osaka Univ. (Japan) . . . . .[7842-79]

14.20: **Investigation of surface damage initiation and growth on KDP third harmonic generation crystals**, Paul P. Demange, Mary A. Norton, Zhi M. Liao, John J. Adams, Ghaleb M. Abdulla, Christopher W. Carr, Lawrence Livermore National Lab. (United States) . . . . .[7842-80]

14.40: **Results of applying a non-evaporative mitigation technique to laser-initiated surface damage on fused silica**, John J. Adams, Jeffrey D. Bude, Masoud Bolourchi, Gabe M. Guss, Ibo J. Matthews, Michael C. Nostrand, Lawrence Livermore National Lab. (United States). . . . .[7842-81]

Coffee Break . . . . .15.00 to 15.30

## SESSION 12

**Room: Auditorium. . . . . Wed. 15.30 to 16.50 pm**

### **Surfaces, Mirrors, and Contamination III**

*Session Chairs:* **Leonid B. Glebov**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States);  
**Semyon Papernov**, Univ. of Rochester (United States)

**15.30: Plasma pre-treatment effect for photo-oxidized coating and adhesion to optical glass surface**, Masataka Murahara, Tokai Univ. (Japan); Yuji Sato, Tokyo Institute of Technology (Japan); Takahisa Jitsuno, Osaka Univ. (Japan); Yoshiaki Okamoto, Okamoto Optics Co., Ltd. (Japan) . . . . .[7842-83]

**15.50: Aqueous HF-based etch process for improving laser damage resistance of fused silica optics**, Tayyab I. Suratwala, Phillip E. Miller, Jeffrey D. Bude, William A. Steele, Nan Shen, Marcus V. Monticelli, Michael D. Feit, Ted A. Laurence, Mary A. Norton, Christopher W. Carr, Lana L. Wong, Lawrence Livermore National Lab. (United States). . . . .[7842-84]

**16.10: How to polish fused silica to obtain surface damage threshold equals to the bulk damage threshold**, Binh T. Do, Sandia National laboratories (United States); Arlee Smith, AS photonics (United States); Rod Schuster, Peter Allard, Troy Alley, David Collier, Alpine Research Optics (United States); Alice Kilgo, Sandia National Laboratories (United States). . . . .[7842-85]

**16.30: Precision grinding for rapid fabrication of fused silica for laser applications**, Xavier Tonnellier, Paul Morantz, Paul Shore, Kevin Howard, Cranfield University Precision Engineering Centre (United Kingdom). . . . .[7842-86]

**Closing Remarks. . . . . Wed. 16.50 to 17.10**

**OPEN HOUSE. . . . . Wed. 17.30 to 19.00**



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## 2009 Award Winners

### Best Oral Presentation:

**Nonlinear spectroscopy: absorption and refraction**  
Paper 7504-64

Authors: **Eric Van Stryland, David Hagan, Scott Webster, Lazaro Padilha**, College of Optics and Photonics, Univ. of Central Florida

### Best Poster Presentation:

**Influence of Na-related defects on DUV nonlinear absorption in CaF<sub>2</sub>: nanosecond versus femtosecond laser pulses**  
Paper 7504-3

Authors: **Christian Mühlig, Herbert Stafast, Wolfgang Triebel, Thomas Zeuner, Christian Karras**, IPHT Jena (Germany); **Martin Letz**, SCHOTT AG (Germany)

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