SPIE. LASER DAMAGE

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2016

LASER DAMAGE

XLVIII ANNUAL SYMPOSIUM ON OPTICAL MATERIALS FOR HIGH-POWER LASERS

TECHNICAL PROGRAM

WWW.SPIE.ORG/LD

Millennium Harvest House Hotel
Boulder, Colorado, USA

Conference
25–28 September 2016

SPIE. LASER DAMAGE 2016

25–28 September 2016

Millennium Harvest House Hotel
Boulder, Colorado, USA

Contents

Welcome

Welcome to the 48th Annual Laser Damage Symposium, also known as 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 will start with a Sunday Evening Tutorial on Advanced Materials for High Laser-Damage Resistance. It will also host the Mini-Symposium on the Review of Large-Scale, High-Power Laser Facility Projects, and the Thin-Film Laser-Damage Competition.

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.

Take time to enjoy beautiful Boulder and its surroundings.
We welcome you to Boulder!

CONFERENCE CHAIRS

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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 (USA)

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CONFERENCE SITE

The Millennium Harvest House Boulder
1345 28th Street, Boulder, CO 80302
www.millenniumhotels.com

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SPECIAL EVENTS

Sunday 25 September

TUTORIAL ON

Advanced Materials for High Laser-Damage Resistance

6:00 to 7:00 pm
Location: Grand Ballroom

Dr. Marco Jupé
Laser Zentrum Hannover (Germany)

This tutorial is focused on the interplay of three major topics of this symposium: optical materials, thin films for optical coatings, and fundamental mechanisms of ultrafast laser-material interactions. This tutorial will address the influence of fundamental material aspects on laser-induced damage. Thereby, the properties of different coating materials and the application of mixture and structuring as well as the laser stack design on the damage are discussed. The main objective is focused on the electronic aspects of laser induced damage.

Welcome and Social Mixer

7:00 to 8:30 pm
Location: Pavilion Gardens

Join your colleagues for light refreshments and mingling.

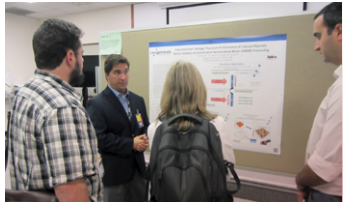
Guest tickets are available onsite for purchase, $30.

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

Monday
26 September

Poster Overviews

10:10 to 10:40 am
Location: Grand Ballroom



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

Poster Viewing and Refreshment Breaks

10:40 am to 11:40 am and 3:40 pm to 4:30 pm
Location: Century Room

Conference attendees are invited to attend the Poster Sessions to review poster papers and interact with the authors who will be at their posters during both sessions.

Please be sure to wear your registration badge.

SPECIAL EVENTS

Standardization Round-Table Discussion

1:20 to 2:15 pm • Location: Millennium Room

This workshop is dedicated to recent developments in the field of International Standardization for optics characterization. Especially ISO 21254, the International Standard for the measurement of Laser Induced Damage Thresholds, is presently subject of a major revision activity within the corresponding Working Group ISO TC 172/SC 9/WG 1 "Terminology and test methods for electro-optical systems." There will be a brief introduction into the present state of the standard and some other standards of interest elaborated within ISO, followed by a discussion of what alterations will be necessary in the present version of ISO 21254 and how it can be adapted to the present needs in practice. Also, further requirements on standardization activities within the community will be considered. Duration about 1 hour.

Sign-up Sheet, and optional boxed lunches will be available for purchase onsite.

Open House and Reception

6:30 to 8:00 pm

Come, relax, and join your colleagues at Research Electro-Optics, Inc. for an enjoyable evening of refreshments and pleasant conversation.

SPONSORED BY:

Tuesday
27 September

Poster Overviews

10:00 to 10:30 am • Location: Grand Ballroom

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

Poster Viewing and Refreshment Breaks

10:30 am to 11:30 am and 3:40 pm to 4:30 pm
Location: Century Room

Conference attendees are invited to attend the Poster Sessions and review poster papers and interact with the authors who will be at their posters during both sessions.

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Wine and Cheese Tasting Reception at NCAR

6:30 to 8:00 pm • Location: NCAR
1850 Table Mesa Dr., Boulder, CO

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

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

Guest tickets are available for purchase, $30 (USD).
Available at registration desk.

FOOD AND DRINK SPONSORED BY :

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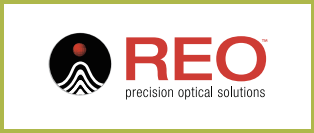

CONFERENCE 10014

Sunday–Wednesday 25–28 September 2016
Proceedings of SPIE Vol. 10014

Laser-Induced Damage in Optical Materials 2016

Conference Chairs: **Greg J. Exarhos,** Pacific Northwest National Lab. (USA); **Vitaly E. Gruzdev,** Univ. of Missouri (USA); **Joseph A. Menapace,** Lawrence Livermore National Lab. (USA); **Detlev Ristau,** Laser Zentrum Hannover e.V. (Germany); **MJ Soileau,** Univ. of Central Florida (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,** Univ. of Rochester (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 25 SEPTEMBER

REGISTRATION MATERIAL PICK-UP
Room: Sunshine Room . . . . . 5:30 pm to 8:30 pm

TUTORIAL
Room: Grand Ballroom . . . . . 6:00 pm to 7:00 pm

Advanced Materials for High Laser-Damage Resistance

Workshop Chair: **Dr. Marco Jupé,** Laser Zentrum Hannover (Germany)

This tutorial is focused on the interplay of three major topics of this symposium: optical materials, thin films for optical coatings, and fundamental mechanisms of ultrafast laser-material interactions. This tutorial will address the influence of fundamental material aspects on laser-induced damage. Thereby, the properties of different coating materials and the application of mixture and structuring as well as the laser stack design on the damage are discussed. The main objective is focused on the electronic aspects of laser induced damage.

WELCOME AND SOCIAL MIXER
Room: Pavilion Gardens . . . . . 7:00 pm to 8:30 pm

Join your colleagues for light refreshments and mingling.

Guest tickets are available onsite for purchase: $30.

Registration Material Pick-up will continue until 8:30 pm.

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

MONDAY 26 SEPTEMBER

REGISTRATION MATERIAL PICK-UP

Room: Sunshine Room . . . . . 7:30 am to 4:00 pm

POSTER PLACEMENT—MONDAY

Room: Century Room . . . . . 7:50 am to 8:20 am

OPENING REMARKS AND AWARD PRESENTATIONS

Room: Grand Ballroom . . . . . 8:20 am to 8:50 am

2015 Best Paper Award Winners

BEST ORAL PRESENTATION

What time-resolved measurements tell us about femtosecond laser damage? [9632-23]

Andrius Melninkaitis, Nerijus Šaulys, Linas Smalakys, Balys Momgaudis, Julius Vaicenavičius, Simona Barkauskaitė, Valdas Sirutkaitis, Vilnius Univ. (Lithuania); **Laurent Gallais,** Aix Marseille Univ., Institut Fresnel (France); **Stephane Guizard,** Ecole Polytechnique (France)

BEST POSTER PRESENTATION

Bulk damage and absorption in fused silica due to high-power laser applications [9632-65]

Frank Nurnberg, Bodo Kühn, Andreas Langner, Mark Altwein, Gerhard Schötz, Ralf Takke, Stephan Thomas, Jan, Vydra, Heraeus Quarzglas GmbH & Co. KG (Germany)

CONFERENCE 10014

SESSION 1

Room: Grand Ballroom . . . . . Mon 8:50 am to 10:10 am

Surfaces, Mirrors, and Contamination I

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

8:50 am: **Laser-matter coupling mechanisms governing particulate-induced damage on optical surfaces** *(Keynote Presentation)*, Manyalibo J. Matthews, Eyal Feigenbaum, Stavros G. Demos, Rajesh N. Raman, Roger Qiu, Nan Shen, Candace D. Harris, Raluca A. Negres, Mary A. Norton, David A. Cross, Christopher W. Carr, Jeffrey D. Bude, Alexander M. Rubenchik, Lawrence Livermore National Lab. (USA) . . . . . [10014-1]

9:30 am: **Study of the laser damage growth in the short-pulse regime**, Martin Sozet, Jérôme Néauport, Eric A. G. Lavastre, Nadja Roquin, Commissariat à l'Énergie Atomique (France); Laurent Gallais, Institut Fresnel (France); Laurent Lamaignère, Commissariat à l'Énergie Atomique (France) . . . . . [10014-2]

9:50 am: **Entry and exit facet laser damage of optical windows with random antireflective surface structures**, Gopal Sapkota, Jason R. Case, Matthew G. Potter, The Univ. of North Carolina at Charlotte (USA); Lynda E. Busse, L. Brandon Shaw, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA); Ishwar D. Aggarwal, Menelaos K. Poutous, The Univ. of North Carolina at Charlotte (USA) . . . . . [10014-3]

MONDAY POSTER OVERVIEWS

Room: Grand Ballroom . . . . . 10:10 am to 10:40 am

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

POSTER VIEWING AND REFRESHMENT BREAK—MONDAY AM

Room: Century Room . . . . . 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 3:40 pm to 4:30 pm.

MONDAY POSTER SESSION

Room: Century Room . . . . . Mon 10:40 am to 11:40 am

Surfaces, Mirrors, and Contamination

In-situ laser-induced micro-damage monitoring using long-distance microscope, Joana C. Alves, European Space Agency (Netherlands); Markus Hippler, Helmut B. Schröder, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Alessandra Ciapponi, European Space Agency (Netherlands); Paul Allenspacher, Wolfgang Riede, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Clemens Heese, European Space Agency (Netherlands) . . . . . [10014-51]

Characterization of the polishing-induced contamination of fused silica optics, Mathilde Pfiffer, Jean-Louis Longuet, Commissariat à l'Énergie Atomique (France); Christine Labrugère, Ctr. National de la Recherche Scientifique (France); Evelyne Fargin, Institut de Chimie de la Matière Condensée de Bordeaux (France); Bruno Bousquet, Ctr. Lasers Intenses et Applications (France); Marc Dussauze, Univ. Bordeaux 1 (France); Sebastien Lambert, Philippe Cormont, Jérôme Néauport, Commissariat à l'Énergie Atomique (France) . . . . . [10014-52]

Laser removal of PVP without causing laser-induced surface damage, Kosuke Nuno, Takanobu Yamashiro, Singo Tuzimoto, Osaka Institute of Technology (Japan); Ryosuke Nakamura, Osaka Univ. (Japan); Seizi Takagi, Takashi Nishiyama, Hideo Horibe, Osaka City Univ. (Japan); Tomosumi Kamimura, Osaka Institute of Technology (Japan) . . . . . [10014-53]

Damage behavior of Nd:glass of high-power disk amplifier medium in ICF Facility, Shaobo He, Univ. of Electric Science and Technology of China (China) and China Academy of Engineering Physics (China); Lin Chen, Xiaodong Yuan, Yuanbin Chen, Xiaofeng Cheng, Xudong Xie, Wenyi Wang, China Academy of Engineering Physics (China); Xiaotao Zu, Univ. of Electronic Science and Technology of China (China) . . . [10014-75]

Materials and Measurements

Characterization of laser-beam ablation profile on PMMA material as a function of practical and theoretical parameters, Luis Alberto V. Carvalho, Univ. de São Paulo (Brazil) and Wavetek Technologies Ltda. (Brazil) . . . . . [10014-54]

Laser-induced bulk damage of silica glass at 355nm and 266nm, Reina Kashiwagi, Shunsuke Aramomi, Nikon Corp. (Japan). . . . . [10014-55]

Investigation of laser-induced ablation of ceramic materials for space-borne applications, Helmut B. Schröder, Markus Hippler, Paul Allenspacher, Wolfgang Riede, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Alessandra Ciapponi, Ana Baselga Mateo, Toncho Ivanov, Jorge Piris, Clemens Heese, Denny Wernham, European Space Research and Technology Ctr. (Netherlands); Joana C. Alves, European Space Agency (Netherlands) . . . . . [10014-56]

CONFERENCE 10014

SESSION 2

Room: Grand Ballroom . . . . . .Mon 11:40 am to 1:00 pm

Surfaces, Mirrors, and Contamination II

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

11:40 am: **Effects of chemical etching on the surface quality and the laser-induced damage threshold of scratched fused silica optics**, Mathilde Pfiffer, Philippe Cormont, Sebastien Lambert, Commissariat à l'Énergie Atomique (France); Evelyne Fargin, Institut de Chimie de la Matière Condensée de Bordeaux (France); Bruno Bousquet, Ctr. Lasers Intenses et Applications (France); Marc Dussauze, Univ. Bordeaux 1 (France); Jérôme Néauport, Commissariat à l'Énergie Atomique (France) . . . . . [10014-4]

12:00 pm: **Laser-induced Hertzian fractures on the exit surface of silica glass deposited with metal microspheres**, Eyal Feigenbaum, Rajesh N. Raman, David A. Cross, Christopher W. Carr, Manyalibo J. Matthews, Lawrence Livermore National Lab. (USA) . . . . . [10014-5]

12:20 pm: **Development of a laser damage growth mitigation process based on CO_2 laser scanning for the laser MegaJoule fused silica optics**, Thomas Doualle, Laurent Gallais, Serge Monneret, Institut Fresnel (France); Stéphane Bouillet, Antoine Bourgeade, Christel Ameil, Laurent Lamaignère, Philippe Cormont, Commissariat à l'Énergie Atomique (France) . . . . . [10014-6]

12:40 pm: **Verification for robustness to laser-induced damage for the Aladin instrument on the ADM-Aeolus satellite**, Denny Wernham, European Space Research and Technology Ctr. (Netherlands); Wolfgang Riede, Paul Allenspacher, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Fabio Era, Alessandro D'Ottavi, Leonardo-Finmeccanica (Italy); Dominique Thibault, Airbus Defence and Space SAS (France). . . . [10014-7]

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

SESSION 3

Room: Grand Ballroom . . . . . .Mon 2:20 pm to 3:40 pm

Thin Films I

Session Chairs: **Jérôme Néauport,** Commissariat à l'Énergie Atomique (France); **Christopher J. Stolz,** Lawrence Livermore National Lab. (USA)

2:20 pm: **Nanosecond laser-induced damage of high-reflection coatings: NUV through NIR** *(Keynote Presentation)*, Zhanshan Wang, Jinlong Zhang, Pengfei He, Bin Ma, Hongfei Jiao, Xinbin Cheng, Tongji Univ. (China) . . . . . [10014-8]

3:00 pm: **Improved manufacturability of high-laser damage threshold ion-beam deposited HfO_2/SiO_2 filters**, Sandeep Kohli, Ralf H. Erz, Jason M. George, Adrian Devasahayam, Veeco Instruments Inc. (USA) . [10014-9]

3:20 pm: **Laser-induced damage of F-SiO_2 protected fluoride based AR coating on a subsurface-damage-free CaF_2 at 193nm**, Jue Wang, Gerald P. Cox, Michael J. D'Lallo, Steven J. Vankerkhove, Jean Francois Oudard, Corning Advanced Optics (USA) . . . . . [10014-10]

POSTER VIEWING AND REFRESHMENT BREAK MONDAY PM

Room: Century Room . . . . . .3:40 pm to 4:30 pm

Posters will be displayed for viewing during refreshment breaks on Monday from 10:40 am to 11:40 am and again from 3:40 pm to 4:30 pm.

SESSION 4

Room: Grand Ballroom . . . . . .Mon 4:30 pm to 6:10 pm

Thin Films II

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

4:30 pm: **Corrosion-resistant AR coating of high-energy alkali laser components using refractory materials**, Zsolt Marton, Harish B. Bhandari, Radiation Monitoring Devices, Inc. (USA); Dennis Sigler, EMF Corp. (USA); Vivek V. Nagarkar, Radiation Monitoring Devices, Inc. (USA). . . . [10014-11]

4:50 pm: **Suppressing multilayer coatings defomation by substrate pit suture**, Yingjie Chai, Meiping Zhu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [10014-12]

5:10 pm: **Electronic quantization in dielectric nanolaminates**, Thomas Willemsen, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Patrick Geerke, Marco Jupé, Laser Zentrum Hannover e.V. (Germany); Laurent Gallais, Institut Fresnel (France); Detlev Ristau, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany) . . . . . [10014-13]

5:30 pm: **Few-cycle pulse laser-induced damage of thin films in air and vacuum ambience**, Kyle R. P. Kafka, Noah Talisa, Drake R. Austin, Kevin Werner, The Ohio State Univ. (USA); Gabriel Tempea, Catalin Neacsu, Spectra-Physics (Austria); Enam A. Chowdhury, The Ohio State Univ. (USA) . . . . . [10014-14]

5:50 pm: **Broadband low-dispersion femtosecond mirror thin film damage competition**, Raluca A. Negres, Christopher J. Stolz, Lawrence Livermore National Lab. (USA); Kyle R. P. Kafka, Enam A. Chowdhury, The Ohio State Univ. (USA); Matthew S. Kirchner, Kevin M. Shea, Meaghan Daly, Kapteyn-Murnane Labs., Inc. (USA). . . . . [10014-15]

CLOSING REMARKS

Room: Grand Ballroom . . . . . 6:10 pm to 6:20 pm

Open House and Reception

MON 6:30 TO 8:00 PM

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

SPONSORED BY: REO precision optical solutions

CONFERENCE 10014

TUESDAY 27 SEPTEMBER

REGISTRATION MATERIAL PICK-UP
Room: Sunshine Room . . . . . 7:30 am to 4:00 pm

POSTER PLACEMENT
Room: Century Room . . . . . 7:50 am to 8:20 am

SESSION 5
Room: Grand Ballroom . . . . . Tue 8:20 am to 10:00 am

Materials and Measurements I

Session Chairs: **Stavros G. Demos,** Univ. of Rochester (USA);
Detlev Ristau, Laser Zentrum Hannover e.V. (Germany)

8:20 am: **Metrology of fused silica** *(Keynote Presentation)*, Frank Nuernberg, Bodo Kuehn, Klaus Rollmann, Heraeus Quarzglas GmbH & Co. KG (Germany) . . . . . [10014-16]

9:00 am: **A double blind study of commercially available CaF_2 absorption, laser-induced damage threshold, and lifetimes at 193nm using an ArF excimer laser**, Jason Yager, Quantel USA (USA); Christian Muehlig, Leibniz-Institut für Photonische Technologien e.V. (Germany) . . . . . [10014-17]

9:20 am: **Nanosecond laser-induced damage of transparent conducting ITO film at 1064nm**, Jae-Hyuck Yoo, John J. Adams, Marlon G. Menor, Tammy Olson, Jonathan R. I. Lee, Amit Samanta, Jeffrey D. Bude, Selim Elhadj, Lawrence Livermore National Lab. (USA) . . . . . [10014-18]

9:40 am: **Study of defects in bulk potassium dihydrogen phosphate by a three-dimensional laser scattering imaging technique**, Jian Chen, Jingtao Dong, Liang Ma, Zhangyao Qian, Zhouling Wu, ZC Optoelectronic Technologies Ltd. (China); Yuanan Zhao, Shijie Liu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [10014-19]

TUESDAY POSTER OVERVIEWS
Room: Grand Ballroom . . . . . 10:00 am to 10:30 am

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

POSTER VIEWING AND REFRESHMENT BREAK TUESDAY AM

Room: Century Room . . . . . 10:30 am to 11:30 am

Posters will be displayed for viewing during refreshment breaks on Tuesday from 10:30 am to 11:30 am and again from 3:40 pm to 4:30 pm.

POSTER SESSION

Room: Century Room . . . . . Tue 10:30 am to 11:30 am

Fundamental Mechanisms

Influence of the size and concentration of precursor on laser damage performance in KDP crystal, Yueliang Wang, Shanghai Institute of Optics and Fine Mechanics (China) and Univ. of Chinese Academy of Sciences (China); Yuanan Zhao, Guohang Hu, Meiping Zhu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [10014-64]

Laser-induced damage threshold characterization of high-bandgap dielectrics with few-cycle femtosecond laser pulses, Noah Talisa, Kyle R. P. Kafka, Kevin Werner, Hui Li, Allen Yi, Enam A. Chowdhury, The Ohio State Univ. (USA) . . . . . [10014-65]

Initial kinetics of defect-initiated nanosecond-pulse laser damage and ablation, Yejia Xu, Luke A. Emmert, David H. Dunlap, The Univ. of New Mexico (USA); Travis Day, Dinesh Patel, Carmen S. Menoni, Colorado State Univ. (USA); Wolfgang Rudolph, The Univ. of New Mexico (USA) [10014-66]

Finite difference time-domain method for simulation of damage initiation in thin film coatings, Linas Smalakys, Balys Momgaudis, Robertas Grigutis, Andrius Melninkaitis, Vilnius Univ. (Lithuania) . [10014-67]

Fine investigations to highlight first stages of fatigue effect in silica, Alexandre Beaudier, Frank R. Wagner, Konstantinos Iliopoulos, Jean-Yves Natoli, Institut Fresnel (France) . . . . . [10014-78]

Thin Films

Study of the picosecond laser damage in HfO_2/SiO_2-based thin-film coatings in vacuum, Alexei Kozlov, Semyon Papernov, James B. Oliver, Amy L. Rigatti, Brittany N. Taylor, Brian Charles, Christopher Smith, Univ. of Rochester (USA) . . . . . [10014-68]

CONFERENCE 10014

Improved LIDT values for dielectric dispersive compensating mirrors applying ternary composites, Thomas Willemsen, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Sebastian Schlichting, Mark Gyamfi, Marco Jupé, Henrik Ehlers, Laser Zentrum Hannover e.V. (Germany); Uwe Morgner, Leibniz Univ. Hannover (Germany); Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) and Leibniz Univ. Hannover (Germany) . . . . . [10014-69]

Preparation of the free-standing silica aerogel thin films and film gratings, Bin Zhou, Ai Du, Tongji Univ. (China) . . . . . [10014-70]

ALD Al_2O_3 coating properties for high-power laser, Hao Liu, Leibniz Univ. Hannover (Germany); Lars O. Jensen, Laser Zentrum Hannover e.V. (Germany); Jürgen Becker, Leibniz Univ. Hannover (Germany); Ping Ma, Chengdu Fine Optical Engineering Research Ctr. (China); Detlev Ristau, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany) . . . . . [10014-71]

What are the impacts of the planarization process on thin film properties?, Travis Day, Hanchen Wang, Brendan A. Reagan, Jorge J. Rocca, Carmen S. Menoni, Colorado State Univ. (USA); Christopher J. Stolz, Lawrence Livermore National Lab. (USA); Paul B. Mirkarimi, James A. Folta, John D. Roehling, Lawrence Livermore National Lab. (USA) and Colorado State Univ. (USA); Ashot S. Markosyan, Stanford Univ. (USA); Roger Route, Stanford Univ. (USA) and Colorado State Univ. (USA); Martin M. Fejer, Stanford Univ. (USA) . . . . . [10014-72]

Optimization of electric field distribution for improved optical resistance in chirped mirror, Simas Melnikas, Simonas Kičas, Ctr. for Physical Sciences and Technology (Lithuania); Linas Smalakys, Gintare Bataviciute, Andrius Melninkaitis, Vilnius Univ. (Lithuania) . . . . . [10014-73]

A study of metal-dielectric mirrors technology with regard to the laser-induced-damage-threshold, Václav Škoda, CRYTUR spol s.r.o. (Czech Republic); Jan Vanda, Institute of Physics of the ASCR, v.v.i. (Czech Republic) . . . . . [10014-74]

Use of Al_2O_3 layers for higher laser damage threshold at 22.5° incidence, S polarization of a 527 nm/1054 nm dichroic coating, John C. Bellum, Ella S. Field, Damon E. Kletecka, Patrick K. Rambo, Sandia National Labs. (USA) . . . . . [10014-89]

SESSION 6

Room: Grand Ballroom . . . . . Tue 11:30 am to 12:50 pm

Materials and Measurements II

Session Chairs: **Carmen S. Menoni,** Colorado State Univ. (USA); **Jianda Shao,** Shanghai Institute of Optics and Fine Mechanics (China)

11:30 am: **Optical absorption spectroscopy with a nano-Kelvin calorimeter**, Behshad Roshanzadeh, S.T.P. Boyd, Wolfgang Rudolph, The Univ. of New Mexico (USA) . . . . . [10014-20]

11:50 am: **Spatially resolved measurement of the residual reflectance at the interface between neodymium laser glass and edge cladding glass for large aperture applications**, Jian Chen, Jingtao Dong, Zhouling Wu, ZC Optoelectronic Technologies Ltd. (China); Lili Hu, Wei Chen, Lei Wen, Junjiang Hu, Tao Meng, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10014-21]

12:10 pm: **Preparing for 3 PW at the Centre for Advanced Laser Applications (CALA) in Munich: Laser damage of optics in vacuum under the microscope**, Christian Kreuzer, Jörg Schreiber, Andreas Welzmueller, Ludwig-Maximilians-Univ. München (Germany) . . . [10014-22]

12:30 pm: **Laser conditioning mechanism revealed by defect and absorption variation in the bulk and at the surface of KDP/DKDP crystals**, Guohang Hu, Yuanan Zhao, Dawei Li, Xiaofeng Liu, Meiping Zhu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10014-23]

Lunch Break . . . . . Tue 12:50 pm to 2:20 pm

SESSION 7

Room: Grand Ballroom . . . . . Tue 2:20 pm to 3:40 pm

Materials and Measurements III

Session Chairs: **MJ Soileau,** Univ. of Central Florida (USA); **Wolfgang Rudolph,** The Univ. of New Mexico (USA)

2:20 pm: **Periodic Review of ISO 21254: U.S. National Committee Proposal for Revision**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Donna J. Howland, Northrop Grumman Corp. (USA); C. Wren Carr, Lawrence Livermore National Lab. (USA); Michael D. Thomas, Spica Technologies, Inc. (USA); John C. Bellum, Sandia National Labs. (USA); Trey Turner, Research Electro-Optics, Inc. (USA) . . [10014-24]

2:40 pm: **Comparison of different LIDT testing protocols for PW and multi-PW class high-reflectivity coatings**, Michal Durák, Daniel Kramer, Praveen K. Velpula, Alexander R. Meadows, Josef Cupal, Bedrich Rus, The Czech Academy of Sciences (Czech Republic) . . . . . [10014-25]

3:00 pm: **Accurate measurement of the onset laser damage threshold**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA) . . . . . [10014-26]

3:20 pm: **Laser scattering imaging of surface and sub-surface defects for large-aperture optics**, Jingtao Dong, Jian Chen, Zhangyao Qian, Zhouling Wu, ZC Optoelectronic Technologies Ltd. (China); Shijie Liu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10014-27]

POSTER VIEWING AND REFRESHMENT BREAK TUESDAY PM

Room: Century Room . . . . . .3:40 pm to 4:30 pm

Posters will be displayed for viewing during refreshment breaks on Tuesday from 10:00 am to 10:30 am and again from 3:40 pm to 4:30 pm.

SESSION 8

Room: Grand Ballroom . . . . . Tue 4:30 pm to 5:50 pm

Materials and Measurements IV

Session Chairs: **Jonathan W. Arenberg,** Northrop Grumman Aerospace Systems (USA); **Joseph A. Menapace,** Lawrence Livermore National Lab. (USA)

4:30 pm: **Laser-induced damage in three-dimensional photonic crystals**, Lei Pan, Dayong Zhang, Yueye Lu, Hongbo Xu, Yao Li, Harbin Institute of Technology (China) . . . . . [10014-28]

4:50 pm: **Plume dynamics from UV pulsed ablation of Al and Ti**, William Bauer, Glen P. Perram, Air Force Institute of Technology (USA) . [10014-29]

5:10 pm: **Laser-induced damage threshold of optical fibers at ns pulses**, Jan Vanda, Mihai-George Muresan, Institute of Physics of the ASCR, v.v.i. (Czech Republic); Matej Sebek, Vojtech Bilek, Czech Technical Univ. in Prague (Czech Republic) . . . . . [10014-30]

5:30 pm: **Laser damage creates backdoors in quantum cryptography**, Shihan Sajeed, Poompong Chaiwongkhot, Univ. of Waterloo (Canada); Mathieu Gagné, Ecole Polytechnique de Montréal (Canada); Jean-Philippe Bourgoin, Univ. of Waterloo (Canada) and Ecole Polytechnique de Montréal (Canada); Carter Minshull, Univ. of Waterloo (Canada); Matthieu Legré, id Quantique SA (Switzerland); Thomas D. Jennewein, Univ. of Waterloo (Canada); Raman Kashyap, Ecole Polytechnique de Montréal (Canada); Vadim V. Makarov, Univ. of Waterloo (Canada) . . . . . [10014-31]

CLOSING REMARKS

Room: Grand Ballroom . . . . . 5:50 pm to 6:00 pm

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TUE 6:30 TO 8:00 PM

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REGISTRATION MATERIAL PICK-UP
Room: Sunshine Room . . . . . 7:30 am to 3:00 pm

SESSION 9
Room: Grand Ballroom . . . . . Wed 8:00 am to 10:00 am

Mini-Symposium: Review of Large-Scale, High-Power Laser Facility Projects I

Session Chairs: **Christopher J. Stolz,** Lawrence Livermore National Lab. (USA); **Stefan H. Borneis,** GSI (Germany)

8:00 am: **ELI-beamlines and its ultrahigh intensity beam transport system** *(Plenary Presentation)*, Stefan H. Borneis, Institute of Physics of the ASCR, v.v.i. (Czech Republic), Gesellschaft für Schwerionenforschung GmbH (Germany); Jean-Baptiste Accary, Lukáš Brabec, Martin Bucka, Institute of Physics of the ASCR, v.v.i. (Czech Republic); Steve Calderon, Pegasus Design, Inc. (United States); Diego de Luis, Institute of Physics of the ASCR, v.v.i. (Czech Republic); David Eimerl, EIMEX Software and Consulting (United States); Georg Korn, Institute of Physics of the ASCR, v.v.i. (Czech Republic); Dieter Heiland, Baudynamik Heiland & Mistler GmbH (Germany); Jana Hejduková, Roman Hvězda, Danila KhiKhlukha, Pavel Korouš, Daniel Kramer, Tomáš Laštovička, Martin Laub, Tadzio Levato, Daniele Margarone, Michael J. Morrissey, Donald A. Peyrot, Ladislav Pust, Bedrich Rus, Jan Řídky, Martin Sokol, Ladislav Stanke, Anita Thakur, Jiří Vaculík, Stefan Weber, Roberto Ziano, Institute of Physics of the ASCR, v.v.i. (Czech Republic) . . . . . [10014-32]

8:30 am: **Laser performance of the SG-III Laser Facility** *(Plenary Presentation)*, Wanguo Zheng, China Academy of Engineering Physics (China) and Shanghai Jiao Tong Univ. (China); Xiaofeng Wei, China Academy of Engineering Physics (China); Qihua Zhu, China Academy of Engineering Physics (China) and Shanghai Jiao Tong Univ. (China); Feng Jing, China Academy of Engineering Physics (China); Dongxia Hu, Jingqin Su, China Academy of Engineering Physics (China) and Shanghai Jiao Tong Univ. (China); Kuixing Zheng, Xiaodong Yuan, Hai Zhou, Wanjun Dai, Fang Wang, Wei Zhou, Dangpeng Xu, Xudong Xie, Bin Feng, Zhi-tao Peng, Liangfu Guo, Yuanbin Chen, Xiong-jun Zhang, Donghui Lin, Zhao Dang, Lanqin Liu, Yong Xiang, China Academy of Engineering Physics (China); Xuewei Deng, China Academy of Engineering Physics (China) and Shanghai Jiao Tong Univ. (China) . . . . . [10014-33]

9:00 am: **Overview of the LMJ: PETAL project** *(Plenary Presentation)*, Jérôme Néauport, Commissariat à l'Énergie Atomique (France) . [10014-34]

9:30 am: **Challenges for robust laser systems of ELI-Beamlines** *(Plenary Presentation)*, Daniel Kramer, Bedrich Rus, Pavel Bakule, Jonathan T. Green, Roman Antipenkov, Jiri Thoma, Jack A. Naylon, Pavel Trojek, Stepan Vyhlídka, Michal P. Košelja, Michal Durák, Praveen K. Velpula, Martin Fibrich, Institute of Physics of the ASCR, v.v.i. (Czech Republic) . . . . . [10014-35]

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

SESSION 10

Room: Grand Ballroom . . . . . .Wed 10:30 am to 12:30 pm

Mini-Symposium: Review of Large-Scale, High-Power Laser Facility Projects II

Session Chairs: **Christopher J. Stolz,** Lawrence Livermore National Lab. (USA); **Stefan H. Borneis,** GSI (Germany)

10:30 am: **Sandia's Z-Backlighter Laser Facility** *(Plenary Presentation)*, Patrick K. Rambo, Jens Schwarz, Marius Schollmeier, Matthias Geissel, Ian C. Smith, Mark W. Kimmel, Christopher S. Speas, Jonathon E. Shores, John C. Bellum, Ella S. Field, Damon E. Kletecka, John L. Porter, Sandia National Labs. (USA) . . . . . [10014-36]

11:00 am: **Overview of large-scale laser at ILE/Osaka University and future plan** *(Plenary Presentation)*, Junji Kawanaka, Osaka Univ. (Japan). . . . . [10014-37]

11:30 am: **Overview of the Orion Laser Facility: update on performance, experimental schedule, and laser operations** *(Plenary Presentation)*, Rory Penman, Mark Girling, David Egan, Stephen P. Elsmere, Ewan J. Harvey, David Ianto Hillier, Dianne Hussey, AWE plc (United Kingdom); Stefan J. F. Parker, Paul A. Treadwell, David N. Winter, Nicholas W. Hopps, AWE plc (United Kingdom) . . . . . [10014-38]

12:00 pm: **Making a precision measurement at metawatt circulation power levels** *(Plenary Presentation)*, Stefan Ballmer, Massachusetts Institute of Technology (USA), LOGO Science Collaboration (USA) . . . . . [10014-77]

Lunch Break . . . . . .Wed 12:30 pm to 1:40 pm

SESSION 11

Room: Grand Ballroom . . . . . .Wed 1:40 pm to 4:00 pm

Fundamental Mechanisms I

Session Chairs: **Vitaly E. Gruzdev,** Univ. of Missouri (USA);
Meiping Zhu, Shanghai Institute of Optics and Fine Mechanics (China)

1:40 pm: **Investigation of mechanisms leading to laser damage morphology** *(Keynote Presentation)*, Laurent Lamaignère, Maxime Chambonneau, Romain Diaz, Pierre Grua, Roger Courchinoux, Commissariat à l'Énergie Atomique (France); Jean-Yves Natoli, Institut Fresnel (France); Jean-Luc Rullier, Commissariat à l'Énergie Atomique (France) . . . . . [10014-39]

2:20 pm: **Morphology and mechanisms of picosecond ablation of metal films on fused silica substrates**, Isaac L. Bass, Lawrence Livermore National Lab. (USA) . . . . . [10014-40]

2:40 pm: **First principles simulation of void and crater formation using the particle-in-cell method**, Alex Russell, Douglass W. Schumacher, Kyle R. P. Kafka, Enam A. Chowdhury, The Ohio State Univ. (USA) . . [10014-41]

3:00 pm: **Electrostatic effects following irradiation of fused silica surfaces with nanosecond laser pulses**, Stavros G. Demos, Univ. of Rochester (USA); Christopher W. Carr, David A. Cross, Lawrence Livermore National Lab. (USA) . . . . . [10014-42]

3:20 pm: **Time-resolved microscopy studies of laser damage dynamics at 0.5-1ps, 1030nm**, Laurent Gallais, Alexandre Ollé, Serge Monneret, Institut Fresnel (France); Martin Sozet, Commissariat à l'Énergie Atomique (France) and Institut Fresnel (France); Jérôme Néauport, Laurent Lamaignère, Commissariat à l'Énergie Atomique (France) . . . . . [10014-43]

3:40 pm: **The effect of ns laser conditioning on the fs laser-induced damage in optical films**, 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, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10014-44]

Refreshment Break . . . . . .Wed 4:00 pm to 4:30 pm

SESSION 12

Room: Grand Ballroom . . . . . .Wed 4:30 pm to 6:30 pm

Fundamental Mechanisms II

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

4:30 pm: **Effect of deuterated levels and impurities on laser-induced damage in DKDP crystals**, Baoan Liu, Xin Ju, Univ. of Science and Technology Beijing (China); Xun Sun, Shandong Univ. (China) . . [10014-45]

4:50 pm: **First-principles calculations for initial electronic excitations in dielectrics induced by intense femtosecond laser pulses**, Shunsuke A. Sato, Kazuhiro Yabana, Univ. of Tsukuba (Japan); Yasushi Shinohara, The Univ. of Tokyo (Japan); Tomohito Otobe, National Institutes for Quantum and Radiological Science and Technology (Japan); Kyung-Min Lee, Max-Planck-Institut für Struktur und Dynamik der Materie (Germany); George F. Bertsch, Univ. of Washington (USA) . . . . . [10014-46]

5:10 pm: **Dual wavelength laser damage mechanisms in the ultrashort pulse regime**, Mark Gyamfi, Marion Costella, Thomas Willemsen, Laser Zentrum Hannover e.V. (Germany); Peter Jürgens, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Mathias Mende, LASEROPTIK GmbH (Germany); Lars O. Jensen, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) . . . . . [10014-47]

5:30 pm: **Ultrafast polychromatic ionization of dielectric solids**, Peter Jürgens, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Marco Jupé, Mark Gyamfi, Detlev Ristau, Laser Zentrum Hannover e.V. (Germany) . . . . . [10014-48]

5:50 pm: **Influence of multiple energy bands on the photoionization of non-metal crystals**, Vitaly E. Gruzdev, Univ. of Missouri (USA); Drake R. Austin, Enam A. Chowdhury, The Ohio State Univ. (USA) . . . . . [10014-49]

6:10 pm: **Simulation of heating by optical absorption in nanoparticle dispersions**, Benjamin C. Olbricht, U.S. Army Research Lab. (USA) . . . . . [10014-50]

CLOSING REMARKS

Room: Grand Ballroom . . . . . 6:30 pm to 6:45 pm

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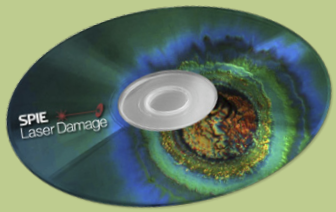

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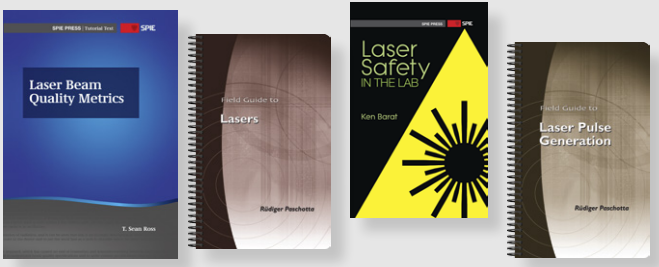

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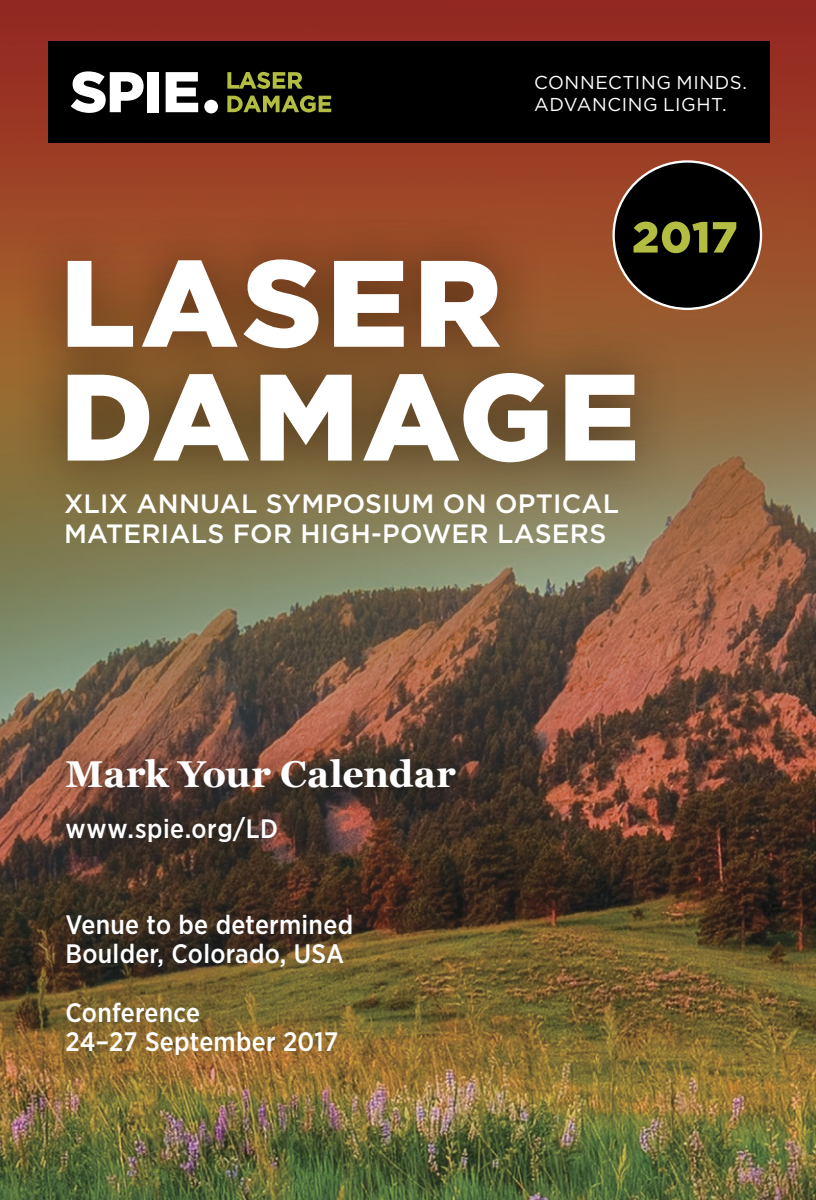
LASER DAMAGE

XLIX ANNUAL SYMPOSIUM ON OPTICAL MATERIALS FOR HIGH-POWER LASERS



Mark Your Calendar

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Venue to be determined
Boulder, Colorado, USA

Conference
24–27 September 2017