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Editors

Gregory J. Exarhos, Vitaly E. Gruzdev, Joseph A. Menapace, Detlev Ristau, M J Soileau

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The International Program Committee of the Laser Damage Symposium XLIV: Annual Symposium in Optical Materials

The International Program Committee of the Laser Damage Symposium is an essential part of the conference gathering representatives from many countries active in the field of high power laser components. Presently, the International Program Committee hosts renowned scientists from the United Kingdom, France, China, Japan, Germany and the United States of America. Besides providing contributions to the conference programme, the International Program Committee is also active in promoting the conference and in attracting researchers from around the world. The members of the International Programme Committee perform a vital service as an outreach for the conference on the global scale. Individuals with suggestions for the meetings are requested to contact any Committee member who is either in acquaintance or in close proximity. The engagement of the International Program Committee, which initiated participation from around 40 countries during the last several years, is acknowledged here as a major contribution to the success of the conference.

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Symposium Welcome

On the Occasion of the Forty-fourth Boulder Damage Symposium

Detlev Ristau

Laser Zentrum Hannover e.V. (Germany)

Welcome to the NIST in Boulder and the 44th Annual Laser Damage Symposium “Laser Induced Damage in Optical Materials”. More than four decades have passed by since the first conference of this kind which was started by Dr. Art Guenther and Dr. Alex Glass inspired by the idea to join forces in the field of high power materials for laser applications. Even after this long time period, laser induced damage in optical materials is continuing to be one of the key issues in laser technology and is often encountered as the limiting factor in many applications as well as the development of high power lasers. The Laser Damage Conference is a clear indicator for this evolution having contributed many tremendous efforts to the fundamental understanding of laser damage and the development of optical components with improved power handling capability.

Again this year, the symposium cochairs, Greg Exarhos, Vitaly Gruzdev, Joseph A. Menapace, M.J. Soileau, and I are especially impressed by the enormous interest and the ever increasing efforts of the scientific community in the four main topics featured by the conference. Among the core topics comprising Materials and Measurements, Fundamental Mechanisms, and Thin Films, as well as Surfaces, Mirrors and Contamination, a major emphasis on the design of new damage measurement schemes, optical materials and ultra-short pulse applications could be observed. Also, fundamental mechanisms predominantly driven by new approaches to the modelling of fs-laser damage are continuously gaining of importance and allow for a deeper understanding of the basic mechanisms. Furthermore, the Mini-Symposium on Laser-Induced Plasma Interactions highlighted recent research trends including plasma-particle interactions, etching of surfaces and laser ablation. Before this background, more than 150 scientists, engineers, and technicians from 13 countries (see Fig. 1) were attracted by the conference which can be considered as the major platform for scientific communication and networking in the field. This outstanding global position of the conference is also reflected by the high number of 45 oral presentations and 30 posters contributed this year. On the basis of this enormous treasury of scientific work, the Proceedings of the Laser Damage Symposium will persist being a primary resource for scientists working in the field and documenting the enormous development of laser technology over more than four decades. Most important, the extraordinary efforts of the authors in preparing the manuscripts, the talks, and the posters to share their results with the community are acknowledged by the symposium staff.

In its early stages, the Boulder Damage Symposium was a national US American conference and kept this format over many years until an International Program Committee had been appointed to represent research activities from different countries and to support the internationality of the conference. Presently, the International Programme Committee consists of representatives from the United Kingdom, France, China, Japan, Germany and the United States of America. Besides providing contributions to the conference programme, the International Program Committee is also active in promoting the conference and in attracting researchers from around the world. The engagement of the International Program Committee, which initiated participation from 40 countries during the last several years, is acknowledged here as being a very important factor to bring the conference to its outstanding success.

On the occasion of the 40th anniversary of the Boulder Damage Symposium a damage competition had been organised with the target to review the present state of the art in high reflecting coatings for the Nd:YAG-laser. This initiative, which was started by Chris Stolz, has found a tremendous resonance within the community and is continued in cooperation with companies and institutes performing the damage threshold measurements. Since then competitions were concentrated on mirrors for ultra-short pulse lasers, antireflective coating for the UV, and mirrors for the ArF-excimer laser operating at 193 nm. Within the framework of the 44th Symposium, the damage competition was dedicated to a thin film polarising beam splitter for the wavelength 1.064 μm of the Nd:YAG-laser and was again very well accepted with a broad variety of participants from all over the world. As a consequence of the enormous number of participants, only the threshold measurements were performed for the p-component under 57° operating angle of incidence this year, whereas the measurement for the s-component will be presented during the upcoming conference. This outstanding effort in performing the measurements is appreciated by the community, and the organizers acknowledge the special contribution by Jeff Runkel. Chris Stolz has prepared a summary paper on the competition which can be found in the present proceedings volume of the conference.

Much of the success of the meeting can be attributed to the untiring efforts of the SPIE staff, as well as of Artika Arpana Lal the Symposium Assistant from the Lawrence Livermore National Laboratory. The organizers also acknowledge the efforts of the NIST staff member Gordon Day and Kent Rochford (NIST-Coordinator) for supporting and hosting the conference at the NIST. Also, co-sponsoring from the Lawrence Livermore National Laboratory, Spica Technologies, and especially, Quantel USA for performing the damage tests for the competition is very much appreciated. Last but not least, special thanks go to ATFilms, Precision Photonics, IDEX Optics&Photonics, Arrow Thin Films, Veeco, the Laboratory of Laser Energetics, Alpine Research Optics, and Rocky Mountain Instruments as contributing sponsors for special events at the Conference.



Fig. 1. Attendees of the Forty-fourth Laser Damage Symposium joining for the traditional conference wine and cheese reception in lobby of the National Centre for Atmospheric Research (NCAR) in Boulder, Colorado, (USA) 25 September 2012.

Summary of Meeting

SPIE Laser Damage
44th Annual Symposium
on Optical Materials for High Power Laser
23-26 September 2012

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1. Abstract

These proceedings contain the papers presented as oral and poster presentations at the 44th Annual Symposium on Optical Materials for High-Power Lasers. The conference was held at the National Institute of Standards and Technology facility in Boulder Colorado on 23-26 September 2012. The symposium was divided into the traditional sessions devoted to the following major topics: thin films; surfaces, mirrors and contamination; fundamental mechanisms; materials and measurements. A mini-symposium devoted to laser-induced plasma interactions was held this year. The starting event of the symposium was a round-table discussion on mechanisms of surface and bulk laser damage held by Stavros Demos and Michael Feit (both with Lawrence Livermore National Laboratory) on Sunday evening. The conference was opened by Dr. Joseph A. Menapace with a symposium welcome. Dr. Gregory J. Exarhos of Pacific Northwest National Laboratory (USA), Dr. Vitaly Gruzdev of the University of Missouri, Columbia (USA), Dr. Joseph A. Menapace of the Lawrence Livermore National Laboratory (USA), Dr. Detlev Ristau of the Laser Zentrum Hannover e.V. (Germany), and Dr. M J Soileau, of the University of Central Florida (USA) co-chaired the symposium. The founding organizers are Dr. Arthur H. Guenther and Dr. Alexander J. Glass.

Eighty-two papers were accepted for presentation at this meeting (same as in 2011), and 75 of them were presented (improvement by seven papers as compared to 2011), including oral and poster presentations plus the mini-symposium. No parallel sessions were held allowing the opportunity to discuss common research interests with all the presenters. With 157 participants attended the meeting (about 5% improvement as compared to 2011), it offered an opportunity to make many new acquaintances. Although held annually in the US, this is a truly International conference with 68 percent of the presentations coming from abroad. As usual, the National Institute of Standards and Technology in Boulder, Colorado, offered a setting conducive to interchanges between individuals working in closely related and complementary fields. We look forward to future opportunities to come together again in this setting.

The 45th Annual Symposium of this series will be held in Boulder, Colorado, 22-25 September 2013. A continuous effort will be made to ensure a close liaison between the high-peak-power and high-average-power laser communities, as well as to include damage issues related to various research efforts and commercial laser applications. Two mini-symposia related to the subject of high-power fiber lasers and laser-damage applications are anticipated. Invited talks are also anticipated to open the four major topical areas and the mini-symposia.

The principal topics to be considered as contributed papers in 2013 do not differ drastically from those enumerated above. We expect to hear more about the laser-damage issues for high-power ultrafast lasers, impacts of defects of optical components on the laser resistance and impacts of material composition/processing techniques since both of these topics continue to generate significant interest. High-energy laser windows, crystals, and transparent ceramics continue to place limitations on laser systems and so remain an active area of research and spirited debate. Refinement of the mitigation strategy consisting of damage initiation followed by arresting damage growth through post-processing techniques while not creating downstream damage is also expected to be a continued focus as a large number of laser-resistant UV optics are manufactured for large-aperture fusion lasers. Short pulse laser optics and damage phenomena remain an active area of research. Recently increased activity in the field of ultra-short-pulse (femtosecond) laser-material interactions is expected to be one of growing topics of the future symposium. We also expect to hear more about new measurement techniques to improve our understanding of the different damage mechanisms or to improve the manufacturing of optical materials and thin films for optical components of greater laser damage resistance.

Fundamental aspects of laser-induced damage including multiphoton and avalanche ionization, scaling of damage threshold with laser and material parameters continue to attract much attention.

As was initially established in 1992, several distinguished invited speakers will make presentations of a tutorial or review nature, in addition, other contributors will cover late-breaking developments of interest to the attendees.

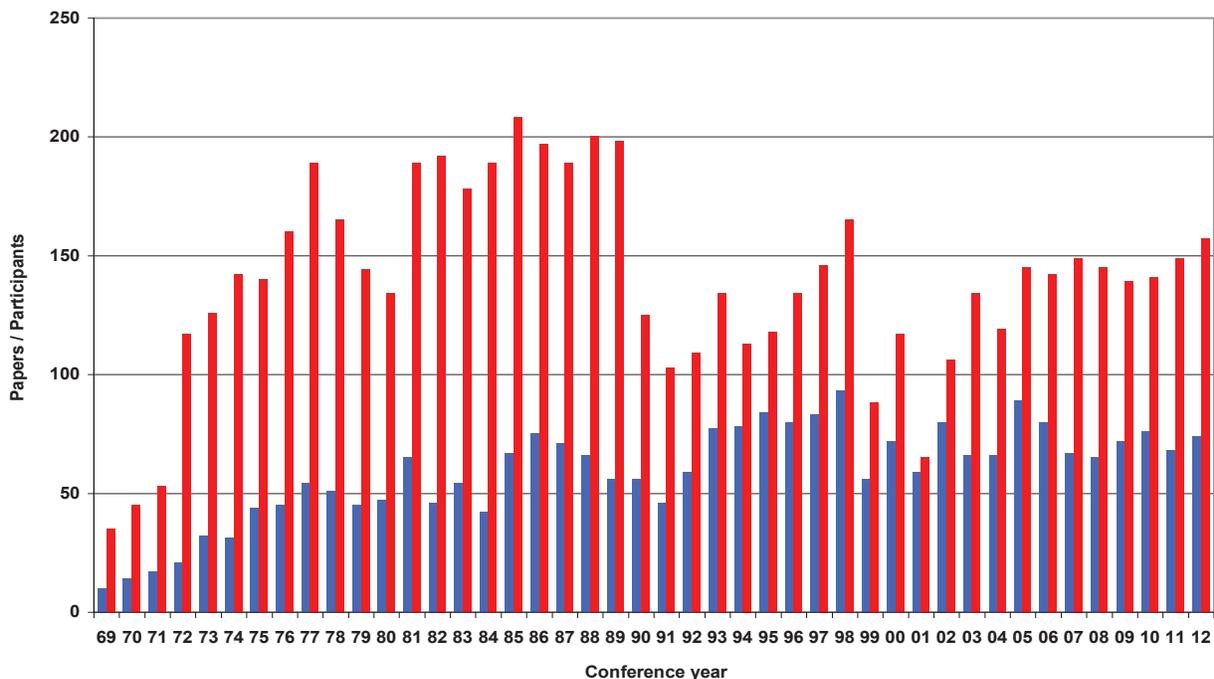
The purpose of this series of symposia is to exchange information about optical materials for high-power / high-energy lasers. The editors welcome comments and criticism from all interested readers relevant to this purpose.

Key words: laser damage, laser interaction, optical components, optical fabrication, optical materials and properties, thin film coatings, contamination.

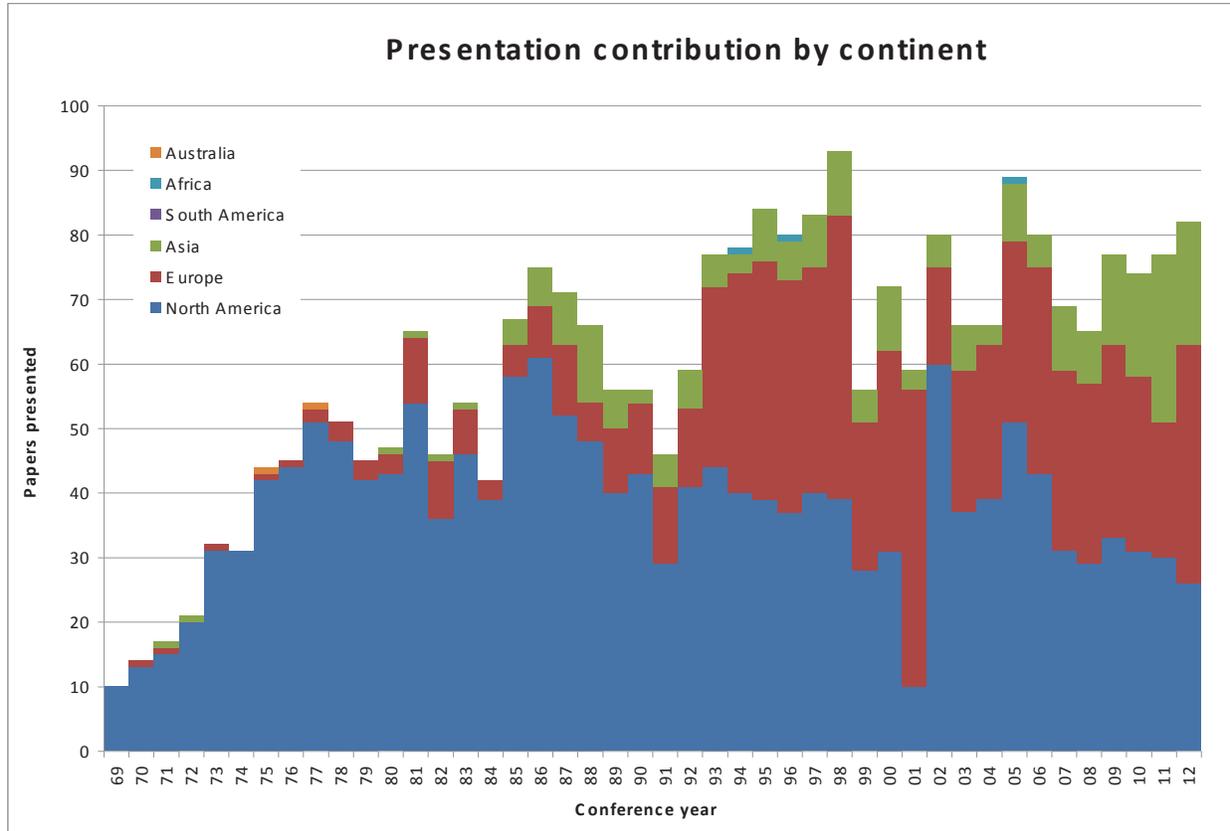
2. Introduction

The SPIE Laser Damage – 44th Annual Symposium on Optical Materials for High-Power Lasers (a.k.a. the Boulder Damage Symposium, because of its Boulder, Colorado, venue) was held 23-26 September 2012. This symposium continues to be the principal US and International forum for the exchange of information relative to the interaction of intense laser light with optical media and components and all aspects of laser damage. This year, it was attended by 157 representatives of academia, industry, national research laboratories and centers from 11 countries. Among 82 paper submittals, 74 presentations were delivered including 45 oral and 30 poster presentations. Although held annually in the US, this is a truly International conference with almost 40 percent of the attendees and 68 percent of the presentations coming from abroad this year. Historically, the meeting has been divided into four categories: thin films; fundamental mechanisms; materials and measurements; and surfaces, mirrors, and contamination. Starting from 1992, a mini-symposium is held to highlight hot research topics and areas of active research and special interest in the research fields related to high-power/high-energy lasers, laser-induced damage, optical materials, laser-material interactions. Starting from 2009, a Round-Table discussion is held on Sunday evening as a pre-symposium event. This year it featured the fundamental aspects of laser-induced damage under the topic “Surface versus Bulk Laser Damage Mechanisms”. The discussion was moderated by Dr. Stavros Demos and Dr. Michael Feit (both with Lawrence Livermore National Lab) and involved more than 55 participants of the conference.

Boulder conference attendance statistics



Registered participants vs number of presented papers since 1969 till 2012 inclusive. Red – participants; blue – presentations.



Distribution of contributed papers by continents from 1969 till 2012 inclusive.

3. Symposium Cochairs

The Boulder Damage Symposium was founded by Dr. A. H. Guenther and Dr. Alexander Glass. Over the last 43 years many prominent leaders within the high-power laser community have contributed significantly as cochairs to this conference. A historical timeline of their contributions is listed below:

- 1969 A. H. Guenther, and A. J. Glass (C. M. Stickley)
- 1979 add H. E. Bennett and B. E. Newnam
- 1981 add D. Milam; A. J. glass departs
- 1987 add M. J. Soileau
- 1988 D. Milam departs
- 1989 add L. L. Chase
- 1994 add M. R. Kozlowski; L. L. Chase departs
- 1997 add G. J. Exarhos and K. L. Lewis; H. E. Bennett and B. E. Newnam depart
- 2001 add C. J. Stolz
- 2002 add N. Kaiser; M. R. Kozlowski departs
- 2004 N. Kaiser departs
- 2005 add D. Ristau
- 2007 A. H. Guenther deceased
- 2008 K. L. Lewis departs
- 2009 add V. Gruzdev
- 2010 add J. A. Menapace; C. J. Stolz departs

4. Thin Films

Because of the tremendous range of applications of optical multilayer coatings for modifying the optical performance of elements (e.g., reflectivity, wavelength sensitivities, polarization, or simply protection), this category continues to receive significant attention. Besides damage thresholds or sensitivity, topics include advanced thin deposition technologies (ion-

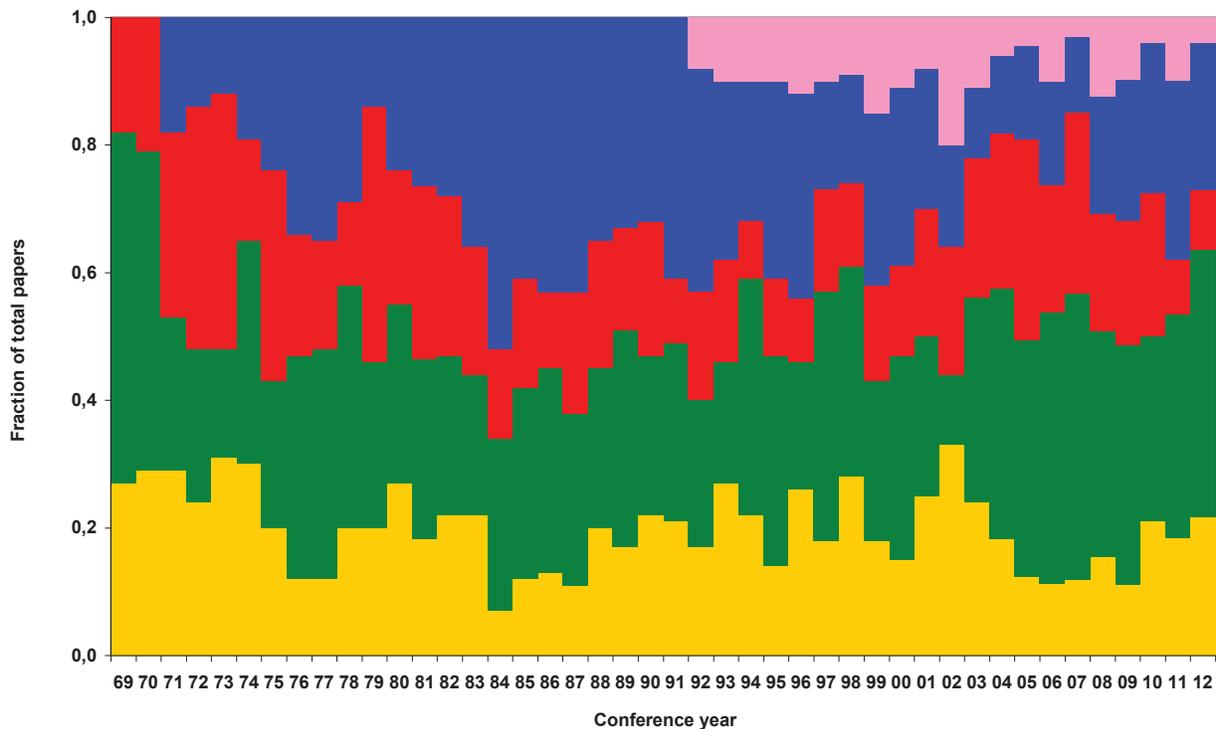
beam sputtering and e-beam evaporation), film structure, film design, film response to environmental attack and aging, and numerous reports on important film properties such as adhesion, thermal conductivity, absorption, stability. Special attention is paid to oxide coatings at 1064 nm, 532 nm, 355 nm, and deep-UV coatings. The problem of thin-film damage by UV and deep-UV pulses continues demonstrating the strong increase of interest due to mass involvement of excimer lasers into industrial production processes. Growing attention is paid to the role of electronic defects of metal-oxide films in initiating of laser damage.

This year the fifth thin-film damage competition was organized by Dr. Christopher Stolz of Lawrence Livermore National Laboratory (USA). Four years ago, it started to sample the industrial, government, and academic sectors producing high laser resistant optical coatings. This year, Brewster angle polarizing beamsplitters with minimum transmission of 95% at p polarization and minimum reflection of 99% at s polarization at 1064 nm and 56.4 degrees angle of incidence from several companies and institutes from the USA, Europe, China, and Japan were tested with 20 ns pulses at the laser-damage test facility of Quantel USA (USA). A multitude of deposition processes, coating materials, and manufacturing techniques submitted to this competition provided some interesting results that will likely lead to some interesting future research.

Dense thin film processes offer the benefit of environmental stability so much of the research in the field of thin films is proceeding in this direction. Laser interaction studies are uncovering areas where dense films offer advantages over traditional e-beam coatings. Also as shown in the thin film damage competition there are a number of companies that are manufacturing dense coatings from a variety of deposition techniques with very high laser resistance.

Coating defects continue to be an area of active interest in both process optimization to minimize defect formation as well as mitigation techniques such as laser conditioning. This year we continued to see interest in thin-film coatings for optics for short-pulse, ultra-short pulse, and DUV laser systems.

Topical emphasis of conference by year



Distribution of presentations by topical area 1969 till 2012 inclusive. From bottom to top: yellow – Fundamental Mechanisms; green – Materials and Measurements; red – Surface, Mirrors, and Contamination; blue – Thin Film; pink – Mini-Symposium.

5. Fundamental Mechanisms

This area deals with the interaction of light with matter – where real system experience is presented. Topics include laser-induced ionization, nonlinear behavior and effects, self-focusing, thermal modeling, and experimental data reduction protocols (e.g. effects of pulse width, repetition rate or duty cycle, spot size, wavelength, temperature, ionizing radiation, and other environmental effects), as well as all types of experimental or material variable scaling relationships that not only afford insight into the fundamentals of the interaction process, but allow extrapolations for engineering and cost-benefit evaluations. In many areas, these insights are based on real-world, systems-level tests, as opposed to a frequently pristine laboratory environment.

A significant amount of experimental and simulation work is now being done in the femtosecond regime as exemplified by the significant number of submitted papers on ultrafast phenomena. This year's presentations demonstrate stable growth of scientific interest and research activity in that field. Significant numbers of presentations also focus on the fundamental influence of defects on laser-induced damage threshold, linear and non-linear absorption, and material response to high-power laser action. This year, novel experimental data were reported by the invited speaker that demonstrated absence of electron avalanche in sapphire and clear avalanche-ionization development in fused silica by action of double femtosecond laser pulses. This novel result demonstrated that the ionization mechanisms responsible for laser damage could be material specific. This point has to be studied in details bearing in mind the advantages of ultrashort-pulse techniques.

6. Surfaces and Mirrors

Presentations of this category are devoted to surface preparation (including MRF technology for large-aperture optics, plasma pre-treatment, aqueous HF-based etching), subsurface damage characterization, roughness and scattering, environmental degradation and aging, as well as substrate material properties, including cooling techniques, and, of course, damage measurement and the cleaning of surfaces. The crux of the contamination problem is fundamentally that damage experiments done in controlled clean laboratory settings do not necessarily yield the same results as laser operations in less pristine operating environments. There is a significant amount of work needed in understanding what contamination is acceptable, what contamination is threatening to optic survivability, and how fluence-limiting or lifetime-limiting contamination can be eliminated or mitigated from operating laser systems.

A fair amount of papers deals with laser-damage mitigation and cleaning processes demonstrating pronounced success in that field. Decontamination and refining of optical surfaces and the impact of contamination on laser resistance still stay the topics of active research and discussion. This year's invited talk featured a highly interesting problem of design and specific effects in multilayer dispersive optics for ultrashort-pulse laser systems for pulse durations approaching the fundamental limit of a single-cycle pulse.

7. Materials and Measurements

Among the four main sections of the conference, this one continuously stays the largest over several last years. This section deals with measurement of laser damage to the bulk of transparent optical media whether amorphous, polymeric, polycrystalline, or crystalline; reports of material properties of importance for their optical function and/or the damage process, e.g., linear and nonlinear absorption coefficients, thermal conductivity, stress-optic coefficients, moduli, scattering, and various defects. Also included are new techniques for measuring these quantities, which present a continuing challenge as materials are improved in quality and diversity. Also, the strong novel trend is towards applications of optical ceramics for production of optics for high-power lasers. Characterization of optical quality and parameters of those materials was reported in the invited talk for this topic.

There is always interest in improved measurement systems or new instruments particularly in the area of non-destructive characterization and defect detection instrumentation. Laser damage measurements are difficult and work continues on developing tests that address large area versus small area and the difficulties of obtaining high resolution data. Significant efforts are reported on investigation of damage precursors, damage initiators, their identification and elimination. Impressive reports are delivered on automated programmable systems for defect identification and blocking for mitigating laser-induced damage. Among the novel techniques for material characterization, application of third-harmonic microscopy was discussed as a new approach to the traditional problems of detection and identification of damage initiators. Continuous efforts have been reported on measurement of absorption for deep-UV optics.

8. Mini-Symposium on Laser-Induced Plasma Interactions

This year the meeting hosted a special mini-symposium focused on the problems of formation of laser-induced plasma by ablation, plasma-particle interactions in the laser-induced plasma, and applications of the plasma for high-sensitivity material spectroscopy. With two oral presentations, it made a highly interesting educational session on Wednesday afternoon that made a bridge between the laser-damage and the laser-plasma communities. The interest to that research area was pumped with the recently reported successful mission of the Mars program and utilizing of the laser-induced plasma techniques for analysis of the soil of Mars. The invited speakers of this mini-symposium were awarded with a honorary gifts from the symposium organizers in recognition of their contribution to success of the symposium.

A brief summary of the past mini-symposium topics starting from 1992 and the organizing chairs is listed below.

<i>Year</i>	<i>Chair</i>	<i>Topic</i>
1992	Brian Newnam	Damage Issues for Lithographic Optics
1993	Karl Guenther	Quest for the Invincible Laser Coating – Critical Review of Pulse Laser-Induced Damage to Optical Coatings: Causes and Cures
1994	Claude Klein	Diamond for Optics Applications in Adverse Environment
1995	Floyd Hovis	Contamination and the Laser Damage Process
1996	Robert Setchell	Laser-Induced Damage in Optical fibers
1997	David Welch	Damage and Lifetime Issues for Laser diodes
1998	Norbert Kaiser	Optics for Deep UV
1999	David Sliney	Laser Damage Processes in the Eye and Other Biological Tissue
2000	Mark Kozlowski Hideo Hosono	Defects in Glass
2001	Mark Kozlowski	Optical Materials for Telecommunications
2002	Detlev Ristau	Optics characterization – joint with 7 th International Workshop of Laser Beam and Optics characterization
2003	William Latham	Understanding Optical Damage with Ultra-short Laser Pulses
2004	Keith Lewis	Damage Issues in Fiber Laser systems
2005	Leon Glebov	Petawatt Lasers
2006	Alan Stewart	Optics in a Hostile Environment
2007	Stan Peplinski	Lifetime Issues for CW and Quasi-CW Lasers
2008	Christopher Stolz Herve Bercegol	Fused Silica
2009	Wolfgang Rudolph	Femtosecond Laser-Induced Damage
2010	Klaus Sokolowski-Tinten	Fundamentals of Laser Ablation
2011	Holger Blashke, Carmen Menoni	Deep-UV Optics
2011	Michelle Shin	Meta-Optics/Photonic Band Gap Materials
2012	Stavros Demos	Laser-Induced Plasma Interactions

9. Plenary Talks

As usual, the 44th Boulder Damage Symposium is highlighted by several invited presentations:

1. “Mechanisms of femtosecond laser ablation of dielectrics revealed by double pump-probe experiment”, Stephane Quizard, Alexandros Mouskeftaras, Nikita Fedorov, Sergey Klimentov, CEA (France).
2. “What role do defects play in the last damage behavior of metal oxides?”, Carmen S. Menoni, Peter Langston, Erik M. Krous, Dinesh Patel, Colorado State University (USA), Luke A. Emmert, The University of New Mexico (USA), Ashot S. Markosyan, Stanford University (USA), Brendan A. Reagan, Keith Wensing, Colorado State University (USA), Roger Route, Martin M. Fejer, Stanford University (USA), Jorge J. Rocca, Colorado State University (USA), Wolfgang Rudolph, The University of New Mexico (USA).

3. “Dispersive multilayer optics: toward high-power applications”, Vladimir Pervak, Ludwig-Maximilians-Univ. Muenchen (Germany).
4. “Coatings of oxide composites”, Lars O. Jensen, Detlev Ristau, Laser Zentrum Hannover (Germany).
5. “Plasma-particle interactions in a laser-induced plasma”, David W. Hahn, Michael E. Asgill, Prasoon K. Diwakar, University of Florida (USA).
6. “Laser ablation for chemical analysis: 50 years”, Richard E. Russo, Jhanis J. Gonzalez, Vassilia Zormpa, Inhee Choi, Lawrence Berkeley National Lab (USA), Alexander A. Bolshakov, Applied Spectra Inc. (USA), Javier Ruiz, Samuel S. Mao, Lawrence Berkeley National Lab (USA), Jong H. Yoo, Applied Spectra Inc. (USA).

10. Conference Awards

Beginning with the meeting in 2000, the organizers instituted a best paper award in the oral and poster categories. The awards appropriately take the form of laser-induced art in an optical glass plaque. (see, e.g., paper by I. N. Trotski, Proc. SPIE 4679, 392-399 (2001)).

There were several outstanding posters and oral papers, however, the following papers were selected:

Best oral paper:

“What role do defects play in the last damage behavior of metal oxides?”, *Carmen S. Menoni*, Peter Langston, Erik M. Krous, Dinesh Patel, Colorado State University (USA), Luke A. Emmert, The University of New Mexico (USA), Ashot S. Markosyan, Stanford University (USA), Brendan A. Reagan, Keith Wensing, Colorado State University (USA), Roger Route, Martin M. Fejer, Stanford University (USA), Jorge J. Rocca, Colorado State University (USA), Wolfgang Rudolph, The University of New Mexico (USA). [85300J]

Best poster paper:

“Bayesian approach of laser-induced damage threshold analysis and determination of error bars”, *Gintare Bataviciute*, Povilas Grigas, Linas Smalakys, Andrius Melninkaitis, Vilnius Univ. (Lithuania) [85301S]

11. In Conclusion

The location in Boulder, Colorado, during autumn at the venue of the National Institute of Standards and Technology and its outstanding facilities and support staff were appreciated by all. The 157 attendees were easily accommodated with ample opportunity to mingle and socialize.

Unusually the weather in Boulder did not encourage a group picture of all symposium participants by the staircase of the National Institute of Atmospheric Research (Boulder, CO) where the traditional Wine and Cheese Reception was held on Tuesday, September 25. This year, since the weather conditions were not favorable for taking pictures outside, the picture was taken on the inner staircase of NCAR.

The organizers of the Boulder Damage Symposium look for opportunities to join with other related groups for joint meetings in the future. For example, in 2002 we had a joint meeting with the 7th International Workshop on Laser Beam and Optics Characterization (LBOC) with no parallel sessions. Also, Pacific Rim Laser Damage (PLD) symposium was held in 2011 from November 6 to November 9 in Shanghai, P. R. China with the topics and the scope completely similar to the topics and scopes of this meeting. The chair of PLD – Dr. Jianda Shao of Shanghai Institute of Optics and Fine Mechanics (China) – kindly delivered an 15-minute overview of PLD to participants on Monday morning, September 24. We are looking forward to developing fruitful collaboration with the PLD meeting in order to join our efforts for better serving the laser-damage community worldwide.

We must also note tireless assistance of SPIE staff who handle the administrative functions of the symposium. Their presence, experience, resources, and professionalism clearly were made manifest with on-line reservations, payment by credit cards, badges, preparation of the abstract book and pocket programs, preparation and printing this volume of Symposium Proceedings, and on-line document service, to which we may add the social functions – thanks to them, “A good time was had by all.”

12. Acknowledgments

A number of volunteers help tirelessly with some of the administrative duties necessary to put on a conference of this magnitude. SPIE took care of all the administrative planning and on-site tasks including setup, registration, and general questions. Artika Arpana Lal from Lawrence Livermore National Lab helped with the registration pick up and at front desk through the entire meeting, and SPIE also took care of program preparation, invitation letters for international participants, and provided much on-line support for the conference as well as preparation of this volume of the conference proceedings and the publication of the manuscripts into it. Artika Arpana Lal from Lawrence Livermore National Laboratory also assisted with the thin-film competition.

This year we acknowledge support from local Colorado companies: ATFilms, IDEX, Arrow Thin Films; Rocky Mountain Instrument Co., Alpine Research Optics, CVI-Melles Griot; Veeco, Semrock, and Precision Photonics Corp. for supporting the social events of this meeting. They are separately acknowledged in this volume of conference proceedings.

Of course, we are all indebted to Kent Rochford, Division Chief of the Optoelectronics Division, who was the prime contact at NIST, for his continued support and encouragement, and Jason Day, also of NIST, was really great with the audio equipment and made the oral sessions run smoothly. On behalf of all the organizers and attendees, we thank them for their tireless efforts.

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Summary of Roundtable Discussion - 2012

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A recently established tradition of SPIE Laser Damage is a Roundtable Discussion held as a pre-symposium event on Sunday evening during registration. In 2009 the Roundtable discussion was held for the first time with the purpose of intellectual warming up for symposium participants and preparing them for active discussions just before the main event of the meeting. Later, the objectives of this event became broader and included educational aspects for students and the participants of the Symposium who are new to the field. The discussion has become a very good platform to exchange opinions and determine global trends and challenges in the field of laser-induced damage.

This year's discussion was the fourth event in this line. Topics of all the Roundtable discussions are listed below:

2009 - Experimental identification of Fundamental LID Mechanisms: Techniques, Challenges, and New Approaches

2010 - Multiphoton vs Avalanche Ionization in LID of Transparent Materials

2011 - Definition and Measurement of Laser-Induced Damage in Transparent Materials by Single Short Laser Pulse

2012 – Surface vs Bulk Laser Damage Mechanisms

This year the discussion was moderated by Dr. Stavros Demos and Dr. Michael Feit (both – Lawrence Livermore National Laboratory, USA) and began with a kick-off presentation delivered by the moderators. The presentation involved both up to date experimental results and theoretical interpretations. The focus was to identify similarities and differences in important physical properties and localized conditions occurring during a damage event induced on the surface vs in the bulk. Although mostly excitation with nanosecond pulses was considered in this discussion, some similarities and differences when using ultrashort pulses were addressed. A special feature of the presentation was the excellent introduction into the many basic aspects of LID on surface and in bulk with special attention paid to the plasma expansion, absorption wave, and contamination effects. The educational aspect of the presentation was appreciated by most feedbacks on the Round-Table. The discussion attracted 55 participants – the highest attendance over the 4-year history of this event. Some 15 more participants joined the Discussion later up on registration.

As previously, the organizers collected feedback from discussion participants in the form of response to 5 questions:

- 1) How interesting was the Roundtable discussion for you?
- 2) Was the Roundtable discussion useful and informative for you?
- 3) Would you participate in Roundtable discussion next year
- 4) Do you have suggestions for improvements?
- 5) Do you have new topics to suggest for the next Round Table Discussion?

This year, responses from 35 participants were obtained (against 16 replies obtained in 2010 and 32 responses obtained in 2011). They said that the event was successful and most participants considered it interesting and useful (Figs. 1-2). Moreover, most attendees were going to attend a Roundtable discussion in 2013 (Fig. 3).

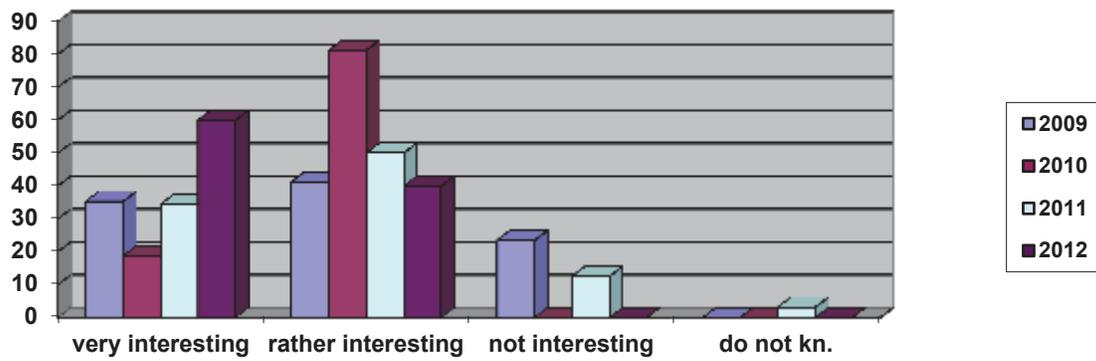


Fig. 1. Distribution of answers to the question “How interesting was the Roundtable discussion for you?” with answer option “very interesting”, “rather interesting”, “nothing interesting”, and “do not know”.

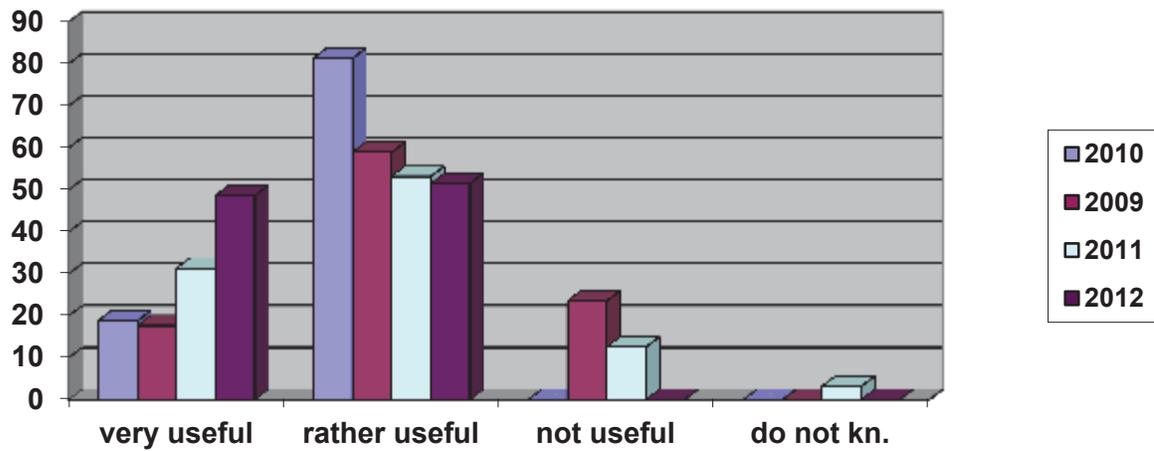


Fig. 2. Distribution of answers to the question “Was the Roundtable discussion useful and informative for you?” with answer option “very useful”, “rather useful”, “not useful”, and “do not know”.

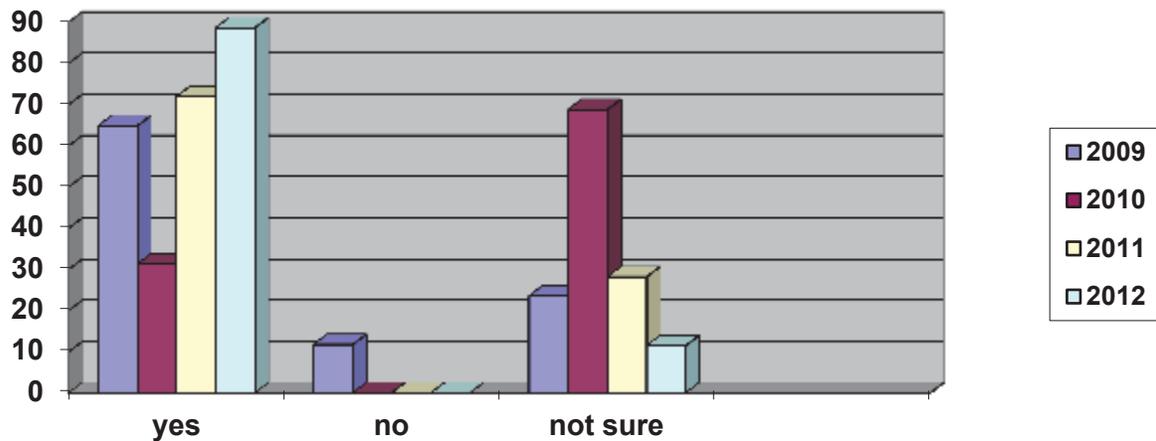


Fig. 3. Distribution of answers to the question “Would you participate in Roundtable discussion next year?” with answer option “yes”, “no”, and “not sure”.

This year, the organizers have received no negative feedbacks about the Round Table. A special acknowledgement goes to the moderators – Stavros Demos and Mike Feit – who have contributed very much to the success of this event. Among the improvements suggested by the feedback, there are mentioned two microphones for the participants, more time for the Discussion, and copies of the kick-off presentation for participants at the beginning of the event. 4-year tracking of the event (see Figs. 1-3 above) shows its growing contribution to the overall success of the Symposium with a strong trend of becoming another attractive feature of the Symposium.

According to the results of the voting performed among participants of the Symposium in 2011, the topic for the Roundtable Discussion–2013 is “Effects of Electric-Field Enhancement in Laser Damage”. Moderators for the discussion are Dr. M. J. Soileau (the University of Central Florida, Orlando, FL) and Dr. Vitaly Gruzdev (University of Missouri, Columbia, MO).

