Summary of Meeting

SPIE Laser Damage
45th Annual Symposium
on Optical Materials for High Power Laser
22-25 September 2013

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Abstract

The 45th Annual Symposium on Optical Materials for High Power Lasers (2013 Laser Damage) is one of the major forums for the presentation of scientific research results in the field of laser damage. Founded more than 4 decades ago in 1969, the conference features the four topics of main relevance in the field: thin films; surfaces, mirrors and contamination; fundamental mechanisms; materials and measurements. In the present summary, besides some factual information on the conference, a brief review on the presented scientific achievements will be given.

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

1. Introduction

The SPIE Laser Damage – 45th Annual Symposium on Optical Materials for High-Power Lasers (a.k.a. the Boulder Damage Symposium, because of its Boulder, Colorado, venue) was held again concurring with the long tradition of this conference series. The present proceedings summarize the papers contributed as oral and poster presentations to the 45th Annual Symposium on Optical Materials for High-Power Lasers. As all previous events of the series also this conference was held at the National Institute of Standards and Technology facility in Boulder Colorado during the time period September 22nd to 25th, 2013. The day before the session started, on Sunday evening, a round table discussion was held dedicated to effects of laser field enhancement in laser-induced damage. The vivid discussion on this current topic was stimulated by the two initiators of the round table, MJ Soileau (with the University of Central Florida, USA) and Vitaly Gruzdev (from the Department of Mechanical and Aerospace Engineering, University of Missouri, USA). The attendees of the conference were welcomed by Vitaly Gruzdev who also congratulated the best poster and oral presentation award winners 2012. This ceremony was assisted by Joseph A. Menapace of the Lawrence Livermore National Laboratory (USA) handing over the glass plaques specially designed for the award winners. Again, the symposium was structured in four separate sessions dedicated to the major interesting topics in laser damage: thin films; surfaces, mirrors and contamination; fundamental mechanisms; materials and measurements. This year program was perfected by a mini-symposium with the title "To high power limits of fiber lasers" which was organized by Leonid Glebov of the University of Central Florida, The College of Optics and Photonics, USA. Dr. Gregory J. Exarhos of the Pacific Northwest National Laboratory (USA), Dr. Vitaly Gruzdev, Dr. Joseph A. Menapace, Dr. Detlev Ristau of the Laser Zentrum Hannover e.V. (Germany), and Dr. M. J. Soileau co-chaired the symposium. The founding organizers of the conference, which was first held in 1969, are Dr. Arthur H. Guenther and Dr. Alexander J. Glass.

Again, many representatives from the international scientific community in the field of laser damage convened to discuss recent results, trends and developments in the four main topics observed within the conference. In the following some statistical aspects of the conference will be presented, and the major scientific trends will summarized in a few paragraphs.

2. Statistics of the Conference

A very high number of 88 papers were accepted for presentation at this meeting (compared to 86 in 2012 and 82 in 2011); however as a consequence of visa and other restrictions, 9 presentations were cancelled. In summary, a total of 80 contributions were presented including one late submission (improvement by 6 papers as compared to 2012). Compared to 2012 a small reduction in the attendee quota from 157 down to 142 was observed for the 45th symposium, which is mainly attributed to the present funding situation in laser related research and the ongoing consolidation of industrial companies to ever increasing business units. Even though, the conference is traditionally organized at the National Institute of Standards and Technology, Boulder, in the United States of America, the majority of the contributions (about 58%) were submitted by research groups and industrial companies from abroad. This clearly indicates the internationality of the conference which is also reflected by the high number of attendees (around 60) from other countries among them China, France, Germany, Japan and many others. Before this background, the Laser Damage Symposium 2013 was again a vivid platform for the interchange of recent research results as well as for scientific communication and networking in the field. This is also expected for upcoming 46th Annual Symposium on Laser-induced in Optical Materials, which will be held in Boulder, Colorado, one week earlier than the regular cycle on September 14th-17th, 2014. This event will feature again a series of non-parallel sessions on the traditional topics and a mini-symposium on thermal management in high power lasers and components. The prospective invited talks will cover recent developments in the four major topical areas and the mini-symposium. We look forward to this future opportunity to come together again.

For a more detailed discussion of the development of the conference over the past decades, a summary on the number of attendees and presented papers is depicted in figure 1. This statistics can be also considered as a basis for an assessment of the laser damage topic complementing the rapid progresses in high power laser technology. Obviously, the highest interest in the topic indicated by the number of participants dates back to the 1980-es, when some principal obstacle in the development of high power optical thin film systems had to be overcome. During this time period a strong community of many research groups in the field of optical coatings was active and performed an enormous variety of investigations in thin film materials, coating designs, deposition processes and their optimization. At the beginning of the 1990 a substantial knowledge basis had been created in this field allowing the realization of high power coating systems with significantly improved laser damage thresholds. As a consequence many companies and research institutes reduced their efforts in this field, and several research groups moved their focus to other areas. This trend is also reflected by the drop in attendance at the beginning of the 1990-es. However, besides optical coating problems, a broad spectrum of challenges on the way towards laser components with ever increasing power handling capability remained. In this context, especially the measurement of laser induced damage thresholds and other quality parameters of optical coatings have to be mentioned. The progresses in the quality of components as for example in optical losses, precise transfer characteristics and power handling capability called for a new generation of improved measurement tools and accompanying international measurement standards. Among others, developments in this field subsisted the Boulder conference over the last decade of the past millennium and lead to a complete set of qualified measurement techniques as well as to a series of ISO-Standards covering measurement practices for absorption losses, optical scattering, spectral transfer characteristics, laser induced damage thresholds and many other parameters. During the last decade, the conference is mainly affected by challenges related to the diversification of laser technology and its applications as well as by the implementation of national high power laser facilities for fundamental research and laser fusion as for example the National Ignition Facility (NIF) of the United States of America or the Project Mégajoule in France. In summary, the topic of laser induced damage was always a major issue in the development of modern laser technology and will persist in the course of the trend to ever increasing output power, beam quality and packing density of advanced laser systems. Finally, it is quite interesting to note, that the number of presented papers in relation to the number of attendees kept consistency over the last 20 years indicating the continuous interest in the field of laser damage. This balanced condition is also based on the number of contribution from abroad which increased drastically and transformed the symposium to an international conference at the end of the beginning of the 1990-es (see fig. 2).

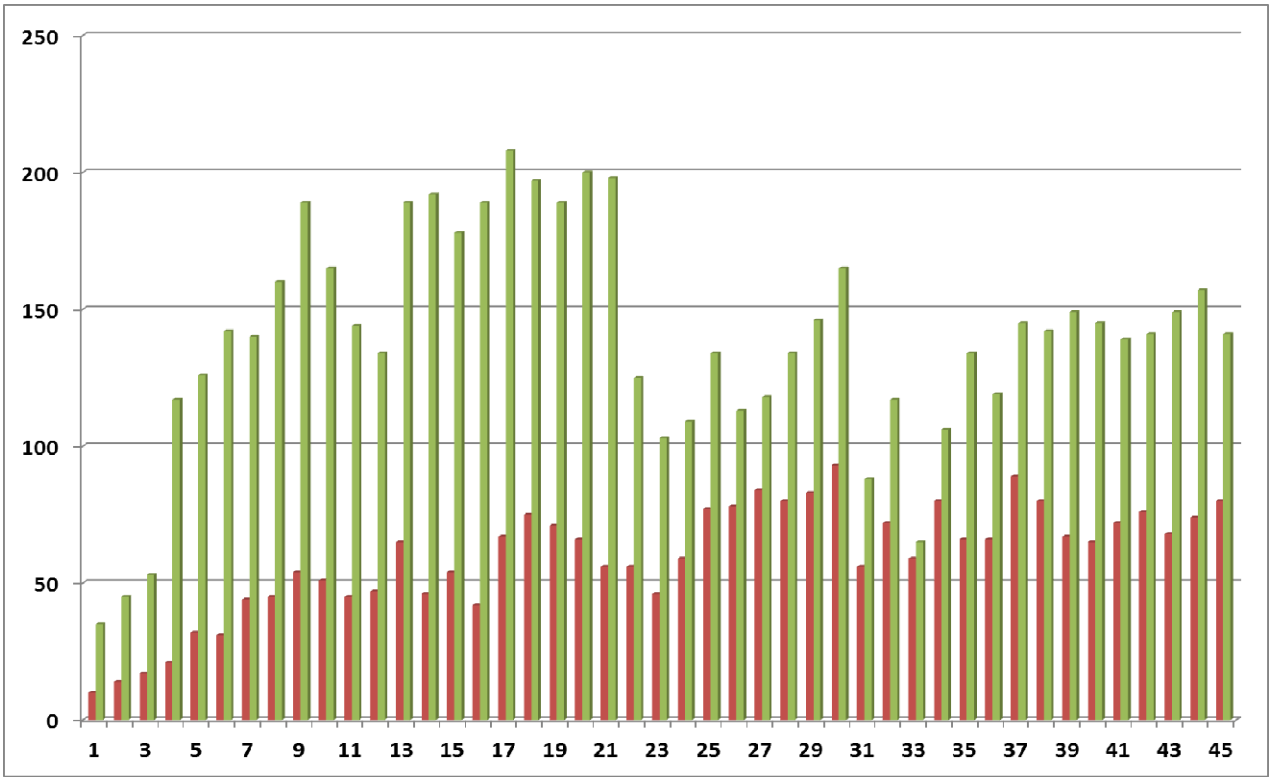

Figure 1: Registered participants and number of presented papers since 1969 including the 45th Laser Damage Symposium 2013. First column per year – presentations; second column – participants.

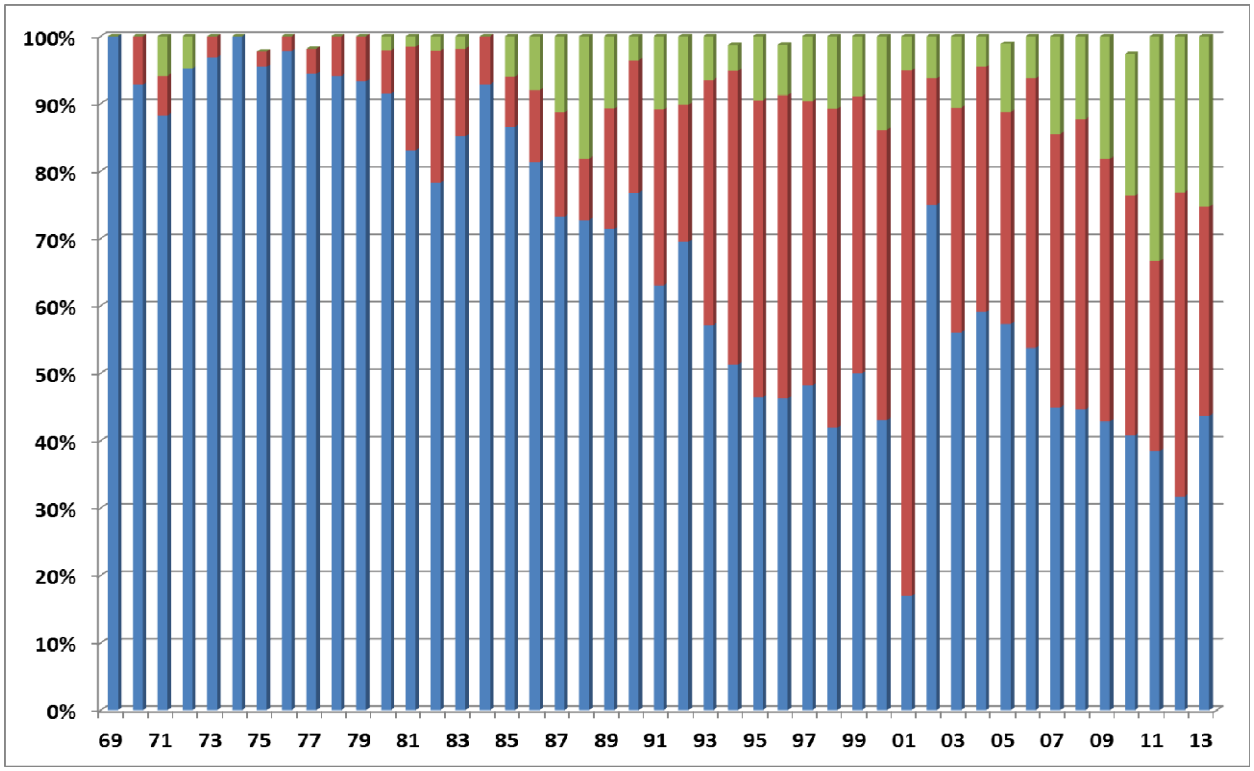

Figure 2: Distribution of contributed papers by continents from 1969. From bottom to top: bottom – North America; second – Europe; top: – Asia.

The Boulder Damage Symposium started as a national workshop and was founded by Dr. A. H. Guenther and Dr. Alexander Glass in the year 1969. As a consequence of the strong interest in the field and related growth of the conference, many scientists within the high-power laser community have contributed significantly as co-chairs to the conference during the past 45 years. 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

3. Executive Summary

A survey of the distribution of presentations by topical area is shown in figure 3. During the conference 2013 the highest number of presented contributions (34) was dedicated to the topic "Materials and Measurements" following the trend of the previous years. Compared to the conference 2012 the research area "Surfaces, Mirrors, and Contamination" gained significantly of importance with 17 presentations. A minute reduction of contributions in respect to 2012 could be observed for the topics "Thin Films" and "Fundamental mechanisms". The regular topics were complemented by four papers devoted to the mini-symposium on high power fiber lasers and a special talk presented by Christopher J. Stolz (Lawrence Livermore National Lab, USA) summarizing the results of the laser damage competition on Brewster angle polarizing beam splitters. In the following, the mentioned topics will be addressed in order of their appearance during the conference.

3.1 Thin Films: This topic was introduced by an invited talk on the role of defects in multilayer mirrors and their production for the NIF presented by Christopher J. Stolz. After a brief outline of the historical development of high power mirrors including the results of material studies, laser conditioning and defect removal, the author concentrated on new methods involving the consecutive deposition of overcoats and ion etching steps for a planarization of optical surfaces. This method is based on the angular dependent etching rate of oxide materials employed for the overcoat and results in a significant reduction of the nodule height in laser mirrors. Defects artificially introduced into a coating structure could be effectively smoothened resulting in an increase of the Laser Induced Damage Threshold (LIDT) to more than 100 J/cm^2 for single pulses of 10 ns duration at the wavelength 1.064 μm. Defects in coatings were also in the focus of the subsequent contributed presentations clearly demonstrating the increasing importance of this subject in research. For example, Semyon Papernow from the University of Rochester, USA, discussed the effect of nanoscale defects (<100 nm) in HfO_2-coatings on fused silica. These defects were investigated with photothermal heterodyne imaging employing a pump laser operating at a
wavelength of 355 nm. A very interesting outcome of the paper was the reduction of absorption by irradiation of the samples with power density of up to 1 MW/cm^2 from a cw-laser at the wavelength 355 nm. This permanent change of up to 70% in absorption was attributed to the depopulation of oxygen vacancy states in the hafnia. In this context the concept and advancements of photothermal microscopy were addressed also by the group of Wolfgang Rudolph (University of New Mexico, USA). As a further interesting topic, Xinbin Cheng from the Tongji University in China considered the effects of mechanical interface strength in Ta_2O_5/SiO_2-multilayers on the laser damage behavior in the ns-pulse duration regime. He could identify a lower strength level for the interface SiO_2/Ta_2O_5 compared to the interface Ta_2O_5/SiO_2 and interpreted this in the context of his LIDT-tests. Further interesting work on thin film mixtures and the wavelength dependence of LIDT was presented by research groups from Lithuania (Simonas Kitas,

Instiute of Physics, Vilnius University) and France (Mireille Commandre, Institut Fresnel). These contributions summarized and complemented the knowledge recently gained on the damage behavior of oxide mixtures in the fs- and ns-pulse duration regime. In contrast to the past conferences interest in coatings for the ultra-short pulse regime faded slightly whereas coating defects continue to be an area of intensive research activities with focus on mitigation strategies and process optimization as well as on detection techniques and post treatment effects.

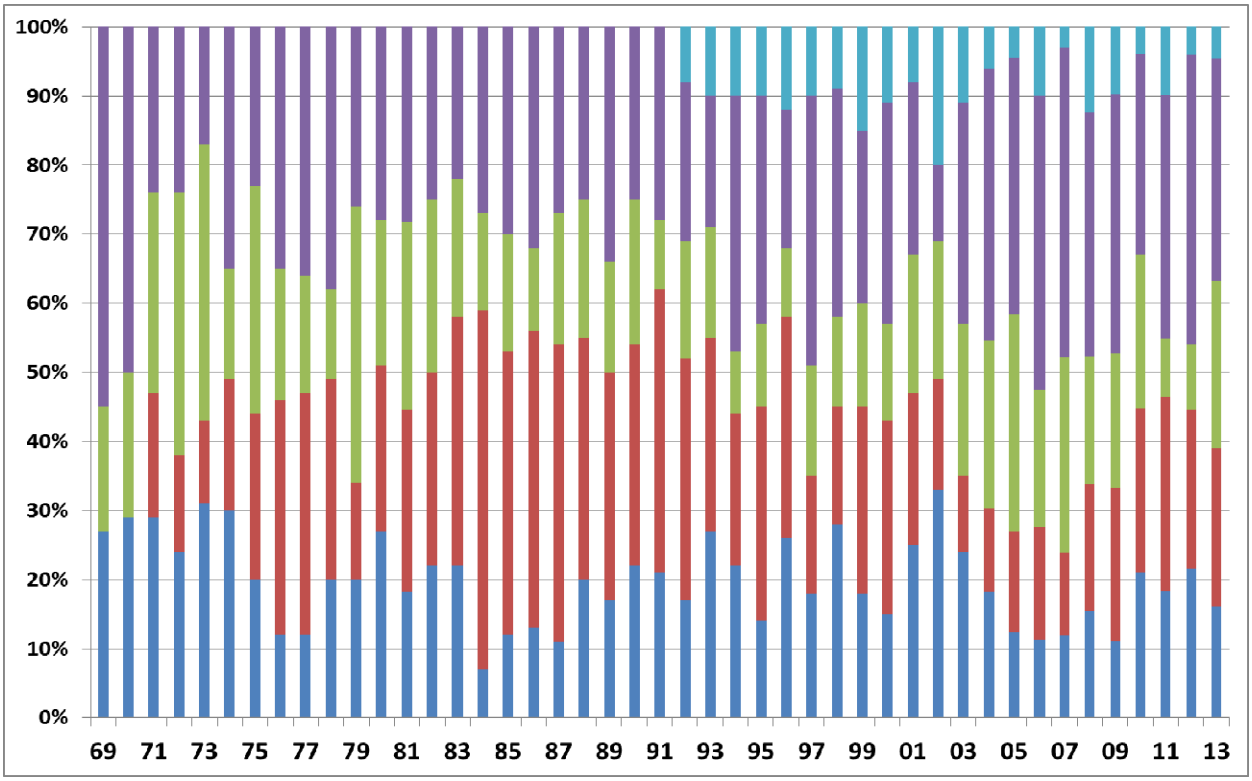

Figure 3: Distribution of presentations by topical area since 1969. From bottom to top: bottom – Fundamental Mechanisms; second – Thin Films; third– Surface, Mirrors, and Contamination; forth – Materials and Measurements; top: – Mini-Symposium.

3.2 Materials and Measurements: The category "Materials and Measurements" was spearheaded by an invited talk on the on status and future capabilities of the National Ignition Facility presented by Paul J. Wagner (Lawrence Livermore National Lab, USA). He summarized the major achievements of the NIF attained since the first operation of this Megajoule class solid state laser starting with around 1 MJ to the present level of 1.8 MJ. Special attention was paid to the inspection and optimization of the coated optics and to the frequency conversion crystals in the system.

The lifetime of space born optics is still a problem of major concern within the community. This was underlined by a talk presented by Wolfgang Riede (Deutsche Zentrum für Luft- und Raumfahrt e.V., Germany) and Denny Wernham (European Space Research and Technology Ctr., Netherlands), who outlined the specific challenges related to the ESA space missions. A clear recommendation was revealed to perform raster scanning in addition to laser damage tests for the qualification of laser optics. A second talk in this series by Oleg A. Konoplev (Sigma Space Corp., USA) was devoted to assessments of optics for a confidence shot lifetime of 1 trillion at orders of magnitude lower fluence levels compared to the intended lifetime of 3 billion shots of the European AELOS mission projected for the fundamental and first two harmonics of the Nd:YAG-laser. The author presented results of test procedures with 1 million shots and their interpretation before the background of accelerated marathon tests up to 1 trillion shots performed with a high repetition rate laser operated at 600 kHz pulse rate. The measurement and evaluation of threshold values were also subject of vivid discussions within the conference.

Even though the ISO measurement standard for LIDT values, ISO 21254, is virtually accepted by the community still some specific difficulties in the described evaluation are to be considered. For example, the results of a round-robin test dedicated to optics for vacuum applications and an improved data reduction scheme were presented by Lars O. Jensen (Laser Zentrum Hannover e.V. Germany). In this context the investigations in advanced evaluation techniques for laser

damage measurement data by Jonathan W. Arenberg (Northrop Grumman Aerospace Systems, USA) have to be mentioned, which propose approaches on the basis of a maximum likelihood estimation. Furthermore, the group of Wolfgang Rudolph (presented by Luke Emmert) revisited techniques for a time resolved transmission measurement of optical components during the course of laser damage. One of the major experimental findings of this study was the observation that the drop in transmission according to the actual event of damage always appeared prior to the temporal maximum of the pulse. The session on materials and measurements featured also studies on defects in coatings exemplified by a comprehensive study performed at Research Electro Optics Inc., USA. This work illustrated by a coworker of the company, Sam Richman, was concentrated on detailed defect statistics and their relation to the damage fluence level. The authors indicated, that the major source of defects may be related to the employed ion beam sputtering process and not to the routinely achievable high cleanliness state of the substrate. Surface contamination was considered within a talk of Douglas S. Hobbs (TelAztec LLC, USA), who showed interesting results of antireflective surfaces produced by etching techniques in comparison to sol gel coatings. LIDT values (355 nm, 10 ns, 250 μm) of up to 27.7 J/cm² were achieved for the etched surfaces compared to the range of 31,6 to 35,6 J/cm² for sol gel coatings. This study was complemented by a contribution on structured optics by an extended research consortium of several universities from the USA.

As a totally different area interest, Paul J. Phillips (Rutherford Appleton Lab, United Kingdom) reported damage thresholds of ceramic Nd:YAG at cryogenic and room temperatures. The authors tested a set of samples with antireflective coatings deposited by different processes for the wavelengths 940 nm and 1030 nm, respectively. In most cases a significant increase of the measured 1 on 1 LIDT values (1030 nm, 3 ns, top hat profile 250 μm) was observed for cryogenic temperatures. For example, the front surface of one sample revealed an augmentation in threshold value from 31.4 J/cm² at 300 K room temperature to 61.1 J/cm² at a temperature at 105 K.

Not least, a variety of measurement techniques were considered in further contributions, for example based on photothermal methods like photoacoustic spectroscopy, laser calorimetry, common path interferometry or Hartmann-Shack sensors.

In summary, investigations in an improvement of the ISO standard for LIDT testing, ISO 21254, could be detected as one essential trend of the present conference. The extrapolation and assessment of the lifetime of optical components is persisting to be an unsolved problem and still attracts various research efforts. Furthermore, the economic production and power handling capabilities of structured optics continue to play an important role in the research activities. Finally, the detection and classification of defects was also discussed within the materials and measurement area clearly indicating the significance of this problem.

3.3 Surfaces, Mirrors, and Contamination: Sessions on this subject contained several papers on the effect of laser ablated debris and laser induced contamination on the power handling capability of optical surfaces. The session series was opened by an invited talk of James E. Andrew (AWE, United Kingdom), who gave a review on effects of focused high energy lasers beams on a variety of plasma targets. Helmut Schröder (Deutsche Zentrum für Luft- und Raumfahrt e.V., Germany) presented a talk on contaminations naphtalene and anthracene deposited on coated surfaces during laser irradiation in specially prepared environments to assess the growth effects and laser interaction mechanisms of the contamination layers. The experiments were aimed at a laser damage risk mitigation for optical components employed in ALADIN mission and involved damage tests at 355 nm at a pulse duration of 10 ns. A drastic reduction of the LIDT values to less than 1 J/cm² could be observed for contaminated surfaces after a few minutes in an environment containing a partial pressure around 0.3 μbar of the aromatic hydrocarbons. Further studies in this area were illustrated by a group from the Osaka University (Hidetoshi Murakami, Osaka University, Japan) and other Japanese research centers. This group concentrated on oil contaminations found in the LFEX Laser system at the Osaka University and reported on a decrease of LIDT values by a factor ½ during 120 hours of operation under a specially prepared atmosphere of N_2 with toluene.

Another remarkable topic of the sessions was the removal of scratches and defects from optical surfaces. Among contributions discussing laser based method, outstanding achievements at the NIF were presented by James A. Folta (Lawrence Livermore National Lab, USA). He introduced the specially established high volume facility for recycling of large NIF optics with laser damage sites. The defect mitigation is achieved on the basis of a CO_2-laser irradiation scheme with dynamic beam diameter and adapted spot sizes controlled by an online imaging system. The facility enables a repair rate of up to 98% and processed already more than 2500 pieces of large scale optics for the NIF. The effects and removal of pre-existing defects and subsurface damage of fused silica were also discussed in several contributions including laser based and magneto-rheological fluid finishing techniques for repair. Within the framework of the development of an ignition facility in China, the influence of scratches with different width on fused silica and plastic surfaces on laser damage thresholds was addressed by a contribution from the Tongji University. The scratches were indented by a diamond tip with different loads in mirror coatings of HfO_2/SiO_2 and laser damage tested under different angles of incidence.

Besides a variety of specific application oriented research activities, clear tendencies towards a deeper understanding of laser induced contamination effects are of continuous importance within the community. Also, the repair of optical surfaces, scratch removal and advanced cleaning techniques are in the focus of present research activities.

3.4 Fundamental Mechanisms: The topic was introduced by a comprehensive survey on the present knowledge on laser damage in dielectric films prepared by Wolfgang Rudolph. He summarized some major aspects of the role of material properties and defects in damage mechanisms induced by ultra-short up to long laser pulses. Theoretical models on the basis of electron photon interaction schemes could be principally confirmed by many experiments in the fs-pulse regime and indicate a predominance of material properties in laser damage mechanisms. However, for longer pulses, the role of intrinsic mechanisms fades, and thermal effects gain of importance for longer pulse durations in the nanosecond region. In this context, especially defects in the coatings have to be considered as a major origin of damage at fluence values far below the expected intrinsic threshold values of dielectric materials. As a consequence, detailed investigations in the different types of defects appearing in dielectric coatings are an essential prerequisite for further progresses in the power handling capability of coatings for longer pulse durations. The authors presented advanced approaches for analyzing defects in coatings including for example photothermal microscopy techniques, time resolved damage studies, and third harmonic microscopy. Besides several articles dedicated to bulk damage in KTP, borosilicate glass, and fused silica presented by authors from the Lawrence Livermore National Lab, USA, and a consortium of French research groups, a comprehensive study on the dynamics of ultra-short pulse damage was published by groups from Lithuania (Vilnius University) and France (Institut Fresnel). The work presented by Nerijus Siaulys (Vilnius University) was concentrated on digital holographic pump probe experiments to resolve the different interaction phases of ultra-short pulse laser radiation with Ta_2O_5 single layers. By tuning the time delay between pump and probe beam, the electron gas generation and plasma dynamics could be recorded, and typical time constants were identified. For example, the highest electron density in the conduction band could be assigned to a time interval of 200 fs, and temperature rises due to lattice heating were observed approximately 1.4 ps after the maximum of the pump pulse (1,030 nm, 300 fs) had passed the sample. The experimental data were found in accordance with theoretical models describing the damage dynamics. This contribution indicates a trend towards studies in detailed models for damage dynamics in thin films and bulk optical material which was also by other publications within the conference. As a further apparent research topic of high interest in the field of fundamental mechanisms again defects in dielectric materials could be identified reflecting one of the general aspects addressed by many talks and posters.

3.5 Mini-symposium: This year the meeting hosted a special mini-symposium focused on fiber lasers and the problems related to the limited power handling capabilities of fibers and their end faces. The mini-symposium was organized by Leonid Glebov and started with an invited talk considering the maximum achievable output powers and energies of present fiber lasers given by a coworker of IPG Photonics Corp. USA. Within the framework of the symposium among other interesting aspects, results on the damage behavior of polished and cleaved fiber end faces were discussed. A study on cw laser damage at 405 nm presented by Cornell P. Gonschior (Technische Hochschule Mittelhessen, Germany) indicated the formation of a ripple structure and color centers in the core region of the fiber leading to losses not acceptable for the application.

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

Year	*Chair*	*Topic*
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 7th 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

3.6 Laser damage competition: In 2013 the second part of the damage competition on Brewster angle polarizing beamsplitters was presented by the organizer Christopher J. Stolz. The double blind experiment was started in 2012 calling for polarizing beamsplitters with minimum transmission of 95% at *p* polarization and minimum reflection of 99% at *s* polarization at 1064 nm under 56.4 degrees angle of incidence. Several companies and institutes from the USA, Europe, China, and Japan sent in samples, which were tested with 20 ns pulses at the laser-damage test facility of Quantel, USA . The presentation complemented the work on p-polarization performed in 2012 by the LIDT data on s-polarization. A few samples were additionally sent in and integrated in the experiment in 2013. The results indicate interesting relations between the threshold values and the multitude of deposition processes, coating materials, and manufacturing techniques involved in this competition. The present test was the last in a row of several competitions started on the occasion of the 40th anniversary of the conference:

2008	HR-mirror for Nd:YAG-laser, 1.064nm, ns-regime
2009	HR-mirror for Ti:Sapphire laser, 780nm, fs-regime
2010	AR-coating for Excimer, 351nm, ns-regime
2011	HR-mirror for Excimer, 193 nm, ns-regime
2012	Brewster angle thin film polarizer, 1.064nm, ns-regime, "p-polarisation"
2013	Brewster angle thin film polarizer, 1.064nm, ns-regime, "s-polarisation"

For the upcoming laser damage conference in 2014, a thin film Fabry-Perot filter for the Nd:YAG-laser wavelength damage tested in the ns-regime will be considered.

3.6 Summary: Again the Laser Damage Conference 2013 hosted an enormous variety of valuable and high quality contributions, all of which cannot be considered in this short synopsis, clearly indicating the high actuality of the tropic and continuous research effort performed by many research groups all over the world. Recording major trends, especially the role of defects in laser damage, contamination effects and the repair of surfaces have to be mentioned among many others.

4. Plenary Talks

The 45th Boulder Damage Symposium is highlighted by several invited presentations introducing the major topics of the conference:

Defect insensitive 100 J/cm^2 multilayer mirror coating process
Christopher J. Stolz, Justin E. Wolfe, Paul B. Mirkarimi, James A. Folta, John J. Adams, Marlon G. Menor, Nick E. Teslich, Regina Soufli, Lawrence Livermore National Lab. (United States); Carmen S. Menoni, Dinesh Patel, Colorado State Univ. (United States)

National Ignition Facility laser performance: status and thoughts on future capabilities
Paul J. Wegner, Lawrence Livermore National Lab. (United States)

A review of laser target debris and shrapnel studies by AWE
James E. Andrew, AWE plc (United Kingdom)

Feasibility of maximum achievable powers and energies in fiber lasers
IPG Photonics Corp. (United States)

Laser damage in dielectric films: What we know and what we don't
Wolfgang Rudolph, Luke A. Emmert, The Univ. of New Mexico (United States); Carmen S. Menoni, Dinesh Patel, Colorado State Univ. (United States)

5. 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)). Among many outstanding posters and oral papers the following papers were selected:

Best oral paper:

Application of time-resolved digital holographic microscopy to study femtosecond damage process in thin films
Nerijus Siaulys, Andrius Melninkaitis, Vilnius Univ. (Lithuania); Laurent Gallais-During, Institut Fresnel (France)

Best poster paper:

Dependence of fs laser resistance of optical materials on wavelength
Laurent Gallais-During, Dam-Be L. Douti, Institut Fresnel (France); Gintare Bataviciute, Egidijus Pupka, Mindaugas Šciuka, Linas Smalakys, Andrius Melninkaitis, Vilnius Univ. (Lithuania); Fabien Lemarchand, Institut Fresnel (France); Valdas Sirutkaitis, Vilnius Univ. (Lithuania); Mireille Commandre, Institut Fresnel (France)

6. Acknowledgments

A number of volunteers help tirelessly with some of the administrate duties necessary to put on a conference of this magnitude. Atrica Lal from Lawrence Livermore National Lab helped with the registration pick up and at front desk through the entire meeting. Artika Arpana from Lawrence Livermore National Laboratory assisted with the thin-film competition. Thanks also to the SPIE staff for their assistance with administrative, program, and proceedings planning.

This year we acknowledge support from local Colorado companies: ATFilms, Arrow Thin Films, Alpine Research Optics, and Precision Photonics Corp. as well as the Laboratory for Laser Energetics in Rochester (all USA) for supporting the social events of this meeting as well as support from the cosponsors Lawrence Livermore National Laboratory and Spica Technologis Inc. Special thanks also to Quantel for performing the enormous work on damage testing for the competition.

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, encouragement, and especially for the organization of NIST tours, as well as Jason Day, also of NIST, who worked really great with the audio equipment and made the oral sessions running smooth. On behalf of all the organizers and attendees, we thank them for their tireless efforts.

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