Optical Interference Coatings (OIC)

June 6–11, 2010, Loews Ventana Canyon Resort and Spa, Tucson, Arizona, USA

OIC - The world's premier meeting for the global technical interchange in the field of optical interference coatings. Learn more.

Pre-Registration is now closed. You may still register on-site at the Loews Ventana Hotel Ballroom Foyer (Tucson, Arizona) beginning Sunday, June 6.

Take advantage of all OIC has to offer:

- Access to technical sessions
- Daily networking lunches
- Tabletop exhibit
- Short courses for professional development
- Renowned experts presenting invited talks.
- Oral previews for all poster presentations
- Poster sessions providing one-on-one discussion time with presenters
- Post Deadline Session reporting critical breakthroughs
- Networking events

Conference Program

View the Agenda
Plan Your Conference

View the conference program and plan your itinerary for the conference

- Browse speakers and the agenda of sessions
- Browse sessions by type or day
- Use Advanced Search to search by author, title, OCIS code and more
- Plan and print your personal itinerary before coming to the conference
- Download your personal itinerary to your mobile device
- Add your personal itinerary to your electronic calendar
- Email your itinerary to a colleague who might be interested in attending

Download pages from the program book!

- Abstracts (pdf)
- Agenda of Sessions (pdf)
- Key to Authors and Presiders (pdf)
- Postdeadline Abstracts (pdf)
- Key to Postdeadline Authors and Presiders (pdf)

Special Opportunities for Students and Young Professionals

Special Events Details

- Kitt Observatory Tour
- University of Arizona Optical Sciences Center Tour
- Special evening session on LIFE: A Path to Laser Fusion Energy
- Welcome Reception
- Poster Sessions
- Post Deadline Sessions

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Program

The program for OIC will be held Sunday, June 6 through Friday, June 11, 2010. Participants may register and pick up their materials starting on Sunday morning.

- Online Conference Program
- Short Courses
- About the meeting topics
- Invited speakers

Online Conference Program

Searchable Conference Program Available Online!

- Browse speakers and the agenda of sessions.
- Browse sessions by type or day.
- Use Advanced Search to search the program by author, title, OCIS code and more.
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- Download your personal itinerary to your mobile device.
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- Email your itinerary to a colleague who might be interested in attending.

You may search the program without creating an account; however, you will not be able to create or save a personal itinerary without first creating an account. We strongly recommend that you create a user account first.

Download pages from the program book!

- Agenda of Sessions (pdf)
- Abstracts (pdf)
- Key to Authors and Presiders (pdf)
- Postdeadline Abstracts (pdf)
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About Optical Interference Coatings

This meeting serves as a focal point for global technical interchange in the field of optical interference coatings. It will include papers on the latest results in research, development and the application of optical coatings. The general areas to be reported on include technologies used in deposition and process control, advances in materials as well as the properties of the various materials used as substrates and as coatings,the latest techniques used for the characterization of optical coatings, advances in computer and analytical design techniques, and the application of optical coatings for solar energy, lighting, display, nano-structures, biological, decorative, laser, lithography, and astronomical applications to mention a few uses.

The conference, like its predecessors, meets every three years and represents an important forum in which the latest advancements in the broad area of optical coatings from research to applications are reported. The format of the meeting includes invited papers by leaders in the field, oral presentations and poster sessions with ample discussion periods. There are no parallel sessions.

Papers were considered in the following topic categories:

Deposition Process Technologies

- Process control, monitoring, and automation
- Low and high energy deposition techniques
- Industrial sputtered metal and dielectric coatings
- Pulsed deposition processes
- Novel deposition methods
- Substrate cleaning and coating post-treatment techniques

Applications

- Coatings for solar energy utilization and environmental control
- Coatings for nanostructures and photonic crystals
- Coatings for Micro-Opto-Electro-Mechanical-Systems (MOEMS)
- Coatings for displays and lighting applications
- Coatings for biological applications
- Coatings for ultrafast applications
- Coatings for astronomical and space applications
- Coatings for short wavelengths EUV, XUV, UV
- Coatings for visible wavelengths
- Coatings for near and far IR spectral regions
- Coatings for polarization management
- Coatings on plastic
- Coatings for security and decorative applications
- Coatings for telecommunication components

Coating and Substrate Materials

- Novel coating materials (nonlinear, organic, electrochromic, electroluminescent, metamaterial, etc.)
- Transparent conductive coatings
- Composite material coatings
- Unusual substrate materials

Characterization and Properties of Coatings

- Fundamentals of thin film growth
- Optical and diffractive properties
- Scattering, absorption, and birefringence
- Micro and nanostructure properties
- Mechanical properties
- Stress, adhesion, and cohesion
- Thermal properties
- Environmental stability
- Laser induced damage
- Optical and non-optical thin film characterization techniques

Design of Coatings

- Computer and analytical design techniques
- Computational manufacturing
- Design of coatings for polarization control
- Multilayers on gratings
- Structured and waveguide coatings

Call for Papers

View the OIC Call for Papers PDF

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Chairs & Committee Members

The Technical Program Chairs and Committee Members are integral to the success of the meeting. These volunteers dedicate countless hours to planning, including such critical activities as raising funds to support the event, securing invited speakers, reaching out to colleagues to encourage submissions, reviewing papers, and scheduling sessions. On behalf of OSA, its Board, and its entire staff, we extend enormous gratitude to the following members of the 17th International Conference on Ultrafast Phenomena Technical Program Committee.

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Information for Conference Chairs and Committee Members

Information for Session Chairs/Presiders

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If you are a member of the committee and have any questions or concerns at any point along the way, please refer to the information below or contact your program manager.

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Information for Conference Chairs and Committee Members

- View the Calendar of Deadlines for the Meeting
- View the Chairs' Manual
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Information for Session Chairs/Presiders

Presiders are requested to identify themselves at least 20 minutes before the session begins to the audiovisual personnel for a quick review of equipment and procedures.

Guidelines

Remember to introduce yourself as the presider and announce the session. The total amount of time allotted for each paper will be listed in the online program as well as in the conference program book. Generally, invited talks are allowed 25 minutes for presentation and 5 minutes for discussion. Generally, contributed talks are allowed 12 minutes for presentation and 3 minutes for discussion. Generally, tutorials are allotted 45 minutes to 1 hour, with 5 minutes for discussion. A 60-minute mechanical timer will be available for your use. We recommend that the timer is set two minutes prior to the end of the presentation time in order to provide a warning to wrap up the talk and start the discussion period. Notify the authors of this warning system. It is also important to remind the speaker to repeat the questions asked from the audience.

Maintaining the scheduled timing of papers is very important. In cases where the paper is withdrawn or the speaker does not show, use the time for an extended question period for authors of previously presented papers or call a break. PLEASE DO NOT START TALKS EARLIER THAN THEY ARE SCHEDULED. All requests to modify the program schedule should be directed to the program chair.

We encourage you to watch a short podcast featuring Dr. Ben Eggleton (*CUDOS, Univ. of Sydney, Australia*) giving tips on how to be a great presider. Or download notes from the podcast.

Speaker Check-in Sheet

Once you arrive at your session room, you'll find a folder at the podium or on the table at the front of the room. This folder will contain a sheet for each session in that room. Please be sure to remove only your session sheet. The check-in sheet will list the talks within your session, the order in which they will be given, and the name of the author giving the presentation. Please be sure to check the box to indicate which speakers presented during the session. Make note of any no-show speakers or replacement speakers. Also, please try to estimate the number of attendees at the session at the start of the session, about halfway into the session, and at the end of the session; note these counts where indicated in the upper right corner. Leave the completed sheet in the folder in the pocket marked "Completed" and leave the folder on the podium or table for the next session presider. The check-in sheet serves two purposes: 1) to assist you in running an effective session and 2) to help us ensure that the appropriate speakers' files are archived on OSA Optics InfoBase after the meeting. Only those authors who attend and present are included in the InfoBase, so it's important that you make note of any presenters who are absent.

View a sample check-in sheet.

IMPORTANT NOTICE: Due to licensing restrictions, the use of music in presentations, including video presentations, is prohibited. If a speaker uses music during his/her presentation, please inform Meeting Management immediately.

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Reserve your exhibit space at the OIC meeting, where nearly 300 industry experts and top scientists and developers will share their latest research and collaborate on new and future applications within this specialized field. Exhibiting at the OIC exhibit offers you an extremely targeted opportunity to display your company's Coating products to top industry experts.

Current Exhibitor List (as of May 25, 2010)

Dynavac
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Leybold Optics
Optilayer
Perkin Elmer
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Thin Film Center
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For More Information about Reserving Exhibit Space at OSA Meetings, please call +1 202.416.1474 or email exhibitsales@osa.org

Exhibitor Service Manual (includes set-up times, registration instructions, checklist of deadlines and shipping instructions)

For additional questions about exhibit logistics, please call +1 202-416-1972 or topicalexhibits@osa.org.

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Special Events

Kitt Peak National Observatory Tour

Thursday, June 10, 2010
Buses Depart at 4:45 p.m.
Buses Return at approximately 10:30 p.m.
Travel time to Kitt Peak is 90 minutes each way.

High atop Kitt Peak sits the largest collection of optical research telescopes anywhere in the world. A special tour of the Kitt Peak National Observatory has been organized for OIC registrants and guests. Tickets are $60 USD per person and includes bus transportation, tour fee and box dinner. ADVANCE REGISTRATION IS REQUIRED BY MAY 25, 2010. To Register for OIC and the tour click here. More information about the tour may be found at http://www.noao.edu/outreach/nop/descr.html.

Evening Session

Monday, June 7, 2010
5:00 p.m.–6:30 p.m.
Grand Ballroom Salon B&C

**LIFE: A Path to Laser Fusion Energy,**
Edward I. Moses; LLNL, USA.

The National Ignition Facility (NIF), the world's largest and most powerful laser system for inertial confinement fusion (ICF) and for studying high-energy-density (HED) science, is now operational and conducting experiments at Lawrence Livermore National Laboratory (LLNL). Demonstration of ignition and thermonuclear burn in the laboratory is a major NIF goal. NIF will achieve this by concentrating the energy from its 192 beams into a mm3-sized target and igniting a deuterium-tritium mix, liberating more energy than is required to initiate the fusion reaction. NIF's ignition program is a national effort managed via the National Ignition Campaign (NIC). Achieving ignition at NIF will demonstrate the scientific feasibility of ICF and will focus worldwide attention on laser fusion as a viable energy option.

A laser fusion-based energy concept that builds on NIF ignition, known as LIFE (Laser Inertial Fusion Engine), is currently under development. LIFE is inherently safe and can provide a global carbon-free energy generation solution in the 21st century. LIFE requires development of advanced technologies such as high-repetition-rate (~10 Hz), high-energy lasers; mass production of targets; and first-wall materials capable of withstanding the high x-ray and neutron fluxes present in the fusion environment. The talk will discuss recent progress on NIF, NIC and the role of NIF in future energy security and frontier science.

Dr. Edward Moses is the Director for the National Ignition Facility (NIF) and the Principal Associate Director for the NIF and Photon Science organization at Lawrence Livermore National Laboratory (LLNL) in Livermore, California.

Dr. Moses was responsible for completing construction and activation of the NIF, the world's largest and most energetic laser system and transforming it into an experimental platform for the broad national and international scientific user community. Experiments on NIF will access high energy density regimes with direct application to strategic security as well as applications for fusion energy research, high energy density science, and astrophysics. Dr. Moses is also the National Director of the National Ignition Campaign to achieve fusion ignition in the laboratory, the culmination of a 50-year quest. The NIF and Photon Science principal directorate is also responsible for the development of
advanced diagnostics and laser technologies for homeland security, economic competitiveness, and energy needs.

Dr. Moses is internationally recognized in laser and optical sciences. He received a BS in 1972 and PhD in 1977, both in Electrical Engineering, from Cornell University. He holds several patents in laser technology, fusion and fission energy, and computational physics. He has received many honors, including the Fusion Power Associates 2008 Leadership Award, the National Nuclear Security Administration Defense Programs Award of Excellence, the Memorial D.S. Rozhdestvensky Medal for Outstanding Contributions to Lasers and Optical Sciences, and the R&D100 Award for the Peregrine radiation therapy program. Dr. Moses is a member of the National Academy of Engineering and a Fellow of SPIE and the American Association for the Advancement of Science.

Evening Session

Tuesday, June 8, 2010
5:30 p.m.–6:30 p.m.
Grand Ballroom Salon B&C

**The Laser at 50: Gain Media, Resonators (Coatings), and Pumping Means,**
Robert L. Byer; Stanford Univ., USA

This year, 50 years since the first demonstration of the laser in May 1960, we celebrate the remarkable advances in laser sources and the very wide range of applications now supported by the laser; once described by the phrase "The laser,a solution looking for a problem." The advances in laser sources could not have happened without corresponding advances in optical coatings. The talk will review, from a laser point of view, the fortunes and misfortunes of optical coatings combined with lasers.

Robert L. Byer has conducted research and taught classes in lasers and nonlinear optics at Stanford University since 1969. He has made numerous contributions to laser science and technology including the demonstration of the first tunable visible parametric oscillator, the development of the Q-switched unstable resonator Nd:YAG laser, remote sensing using tunable infrared sources and precision spectroscopy using Coherent Anti Stokes Raman Scattering (CARS). Current research includes the development of nonlinear optical materials and laser diode pumped solid state laser sources for applications to gravitational wave detection and to laser particle acceleration.

He served Chair of the Applied Physics Department at Stanford University from 1980 through 1983 and 1999 through 2002. He served as Associate Dean of Humanities and Sciences from 1984 through 1986 and served as Vice Provost and Dean of Research at Stanford University from 1987 through 1992. From 2006 through 2008 he served as the Director of Edward L. Ginzton Laboratory after serving as Director of Hansen Experimental Physics Laboratory from 1997 through 2006.

Professor Byer is a Fellow of the Optical Society of America, the Institute of Electrical and Electronics Engineers (IEEE), the American Physical Society and the American Association for the Advancement of Science and the Laser Institute of America. In 1985 Professor Byer served as president of the IEEE Lasers and Electro-optics Society. He was elected President of the Optical Society of America and served in 1994. He is a founding member of the California Council on Science and Technology and served as chair from 1995 - 1999. He was a member of the Air Force Science Advisory Board from 2002-2006 and has been a member of the National Ignition Facility Advisory Committee since 2000.

Professor Byer has published more than 500 scientific papers and holds 50 patents in the fields of lasers and nonlinear optics. Professor Byer was elected to the National Academy of Engineering in 1987 and to the National Academy of Science in 2000.

This exciting talk is being given in conjunction with LaserFest. LaserFest is a yearlong celebration of the 50th anniversary of the laser, which was first demonstrated in 1960, and is a collaboration between the American Physical Society, the Optical Society , SPIE and IEEE Photonics Society . From DVD players to eye surgery, the laser is one of the greatest inventions of the 20th century—one that has revolutionized the way we live.

LaserFest emphasizes the laser's impact throughout history and highlights its potential for the future. Through a series of events and programs, LaserFest showcases the prominence of the laser in today's world. For more information, visit www.LaserFest.org .

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Author and Presenter Information

Scroll down to the relevant step in the timeline below to find more information on the topic.

Author Timeline

October 2009	Call for Papers Opens
By January 18, 2010	Prepare and Submit Your Work to the Meeting
January 18, 2010, 12:00 p.m. noon EST (17.00 GMT)	Abstract and Summary Submissions Due
February 4–16, 2010	Peer Review
Late February 2010	Program Committee Meeting/Decisions
Week of March 5, 2010	Authors Notified of Committee Decisions
Mid-March 2010	Online Program Planner Available
By March 29, 2010	Eligible Students: Apply for a Student Travel Grant
By May 4, 2010	Make Your Housing Arrangements
By May 25, 2010	Register for the Meeting
May 26, 2010	Postdeadline Abstract and Summary Submissions Due
Late May 2010	Postdeadline Submissions Peer Review
Early June 2010	Postdeadline Authors Notified of Committee Decisions
Early June 2010	Prepare to Present at the Meeting
June 6–11, 2010	Present at the Meeting
By week of June 28, 2010	Presented Papers Available in Optics InfoBase
By August 1, 2010	Submit a paper to the OIC Applied Optics Feature Issue

Prepare and Submit Your Work to the Meeting

Deadline: January 18, 2010 (12:00 noon EST, 17.00 GMT)

The submission deadline has passed. If you have new and significant material, you are encouraged to submit a Postdeadline paper for consideration.

Peer Review

Submissions to OSA meetings undergo a peer review conducted by the members of the Technical Program Committee. The results of the peer review translate into presentation selections and topic-driven technical sessions for the meeting. Maintaining a thorough peer review process ensures the high quality of the presentations offered at the meeting. Summaries, as submitted by the authors, of all accepted papers will be included on the Technical Digest CD-ROM distributed at the meeting. Summaries of all presentations made at the conference will be archived in Optics InfoBase after the conference.

Program Committee Meeting/Decisions

The Technical Program Committee meets, either in person or online, to determine which submissions will be accepted for presentation and then to group those accepted presentations into sessions. The decisions of the program committee meeting, regarding both acceptance and scheduling, are final.

Eligible Students: Apply for a Student Travel Grant

Deadline: March 29, 2010

The OSA Foundation is pleased to offer travel grants to students working or studying in a qualifying developing nation who plan to attend Optical Interference Coatings (OIC). Go to the OSA Foundation Travel Grant page for details on criteria and application requirements.

Authors Notified of Committee Decisions

After the Technical Program Committee meeting, the corresponding/presenting author will receive official notification of the committee's decision. This notification will come from osa@abstractsonline.com. It is important that you add this address to the "safe list" in your email software to ensure that you receive the notification. Note that the notification is sent to only the corresponding/presenting author, and that author is expected to share the notification with any co-authors. The decisions of the program committee meeting, regarding both acceptance and scheduling, are final.

Online Program Planner Available

The online program planner is available a few days after author notifications are sent. The online program planner allows you to browse speakers and the agenda of sessions and perform simple and advanced searches to identify parts of the program that are of interest to you. Use the online program planner to build a custom itinerary-not only can you plan and print your personal itinerary before coming to the meeting, you can also add your itinerary to your electronic calendar, download it to a personal mobile device or email it to a friend or colleague who might be interested in attending the meeting.

Prepare to Present at the Meeting

To ensure a successful presentation at the meeting, make sure to remember the following:

- Secure your visa early! Click here for visa application information and invitation letter requests
- Prepare your presentation according to the guidelines:
  - Oral Presentation Guidelines
  - Poster Presentation Guidelines

Postdeadline Abstract and Summary Submissions Due

Postdeadline Submissions Deadline: May 26, 2010, 12:00 p.m. noon EDT (16.00 GMT)

The purpose of postdeadline papers is to give participants the opportunity to hear new and significant material in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness are accepted for postdeadline presentation. If you believe your work meets these requirements, you are encouraged to submit a postdeadline paper by following the instructions below:

- Read the Call for Papers.
- Review the Submission Guidelines and prepare your submission according to the instructions, using the provided templates.
- Log on to the submission site to complete your submission.
- If you would like a confirmation of your submission emailed to you, be sure to select this option during the submission process.
- Official notification will be sent to the corresponding/presenting author of accepted presentations by [date].

- If you have questions about your submission, call +1.202.416.6191 or send an email to cstech@osa.org.

Register for the Meeting

Pre-registration deadline: May 25, 2010. Register before this deadline to take advantage of savings!

Reminder: All presenters and presiders are required to register.

Make your Housing Arrangements

Secure housing within the official housing block, available through May 4, 2010.

Postdeadline Submissions Peer Review

All contributed submissions to OSA meetings, including postdeadline submissions, undergo a peer review conducted by the members of the Technical Program Committee. The results of the peer review translate into presentation selections for the meeting. Maintaining a thorough peer review process ensures the high quality of the presentations offered at the meeting

Postdeadline Authors Notified of Committee Decisions

The corresponding/presenting author will receive official notification of the committee's decision. This notification will come from osa@abstractsonline.com. It is important that you add this address to the "safe list" in your email software to ensure that you receive the notification. Note that the notification is sent to only the corresponding/presenting author, and that author is expected to share the notification with any co-authors. The decisions of the program committee meeting, regarding both acceptance and scheduling, are final.

Present at the Meeting

To ensure that the program runs smoothly, all speakers are requested to upload their presentations on the respective session room laptop at least one full coffee break prior to their session.

The meeting rooms will contain the following:

- Laptop computer with Windows XP and Microsoft Office 2000.
- LCD projector
- Podium microphone
- Projection pointer

Mac users should bring along a compatible VGA plug or the cable that converts Firewire to VGA which comes with the purchase of the laptop.

Additional equipment will be made available only by special arrangement. The attendee will be responsible for the cost of any video equipment. Contact the Meetings Department with your request for other equipment.

Please note that Internet access will not be available during your presentation, and due to licensing restrictions, the use of music in presentations, including video presentations, is prohibited.

Optical Interference Coatings (OIC)

June 6–11, 2010, Loews Ventana Canyon Resort and Spa, Tucson, Arizona, USA

Program

Invited Speakers

MA1, Some Current Topics in Optical Coatings, ***H. Angus Macleod****; Thin Film Ctr., USA*

MB1, 2010 OSA Topical Meeting on Optical Interference Coatings: Manufacturing Problem, ***George Dobrowolski****, Li Li; Natl. Res. Council Canada, Canada*

MC1, State of the Art of Photonic Structures for Solar Cells, ***Ludovic Escoubas****, Jean-Jacques Simon, Philippe Torchio, David Duché, Sylvain Vedraine, Wilfried Vervisch, Judikael Le Rouzo, Francois Flory, Guillaume Rivière, Gizachew Yeabiyo, Hassina Derbal; Aix-Marseille Univ., France*

MD1, Plasma Assisted Deposition of Metal Fluoride Coatings, ***Martin Bischoff*****[1,2]***, Dieter Gäbler[2], Norbert Kaiser[2]; [1]LINOS Photonics GmbH & Co. KG, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany*

TuA1, Modern Design Approaches and a New Paradigm of Constructing a Coating Design, ***Alexander V. Tikhonravov****; Res. Computing Ctr., Moscow State Univ., Russian Federation*

TuB1, 2010 OSA Topical Meeting on Optical Interference Coatings: Design Problem, ***Karen D. Hendrix*****[1]***, James Oliver[2]; [1]JDSU, USA, Lab for Laser Energetics, [2]Univ. of Rochester, USA*

TuC1, An Overview of Basic and Advanced Optical Monitoring Techniques, ***Brian T. Sullivan****, Graham Carlow; Iridian Spectral Technologies, Canada*

TuD1, Cluster Ion Beam Assisted Thin Film Deposition, ***Noriaki Toyoda****, Isao Yamada; Univ. of Hyogo, Japan*

WA1, Nanoscale Coatings, ***Norbert Kaiser*****[1]***, Martin Bischoff[1,2], Torsten Feigl[1], Ulrike Schulz[1], Olaf Stenzel[1]; [1]Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany, [1]LINOS Photonics GmbH & Co. KG, Germany*

WB1, Quantum Confinement and Optical Properties of Nanostructured Thin Films, ***François R. Flory*****[1]***, Yu-Jen Chen[2], Ludovic Escoubas[2], Jean-Jacques Simon[2], Philippe Torchio[2], Vincent Brissonneau[2], David Duché[2], Renaud Bouffaron[2]; [1]École Centrale Marseille, France, [2]Paul Cézanne Univ., France*

WC1, Polarizing and Non-Polarizing Thin Film Coatings, ***Li Li****; Natl. Res. Council Canada, Canada*

WD1, Optical Coatings under Load, ***Alan F. Stewart****; Boeing, USA*

ThA1, Coating Materials for High Quality Films, ***Bram Vingerling***; *Merck KGaA, Germany*

ThC1, 2010 OSA Topical Meeting on Optical Interference Coatings: Measurement Problem, ***Angela Duparré*****[1]***, Detlev Ristau[2]; [1]Fraunhofer Inst. Angewandte Optik und Feinmechanik, Germany, [2]Laser Zentrum Hannover e.V., Germany*

ThB1, Optical Interference Coating Curriculum at the University of Rochester's Institute of Optics, ***Jennifer Kruschwitz*****[1]***, James B. Oliver[2]; [1]JK Consulting, USA, [2]Univ. of Rochester, USA*

ThD1, Angle Resolved Scattering from Optical Filters for Space Applications, ***Peter Fuqua*****[1]***, Tom Mooney[2], J. D. Barrie[1], David Rock[1], H. I. Kim[1]; [1]Aerospace Corp., USA, [2]Barr Associates, Inc., USA*

ThE1, Spectrophotometric Measurements, ***Maria Nadal****; NIST, USA*

FA1, Coatings for High Power Lasers, ***Hongbo He****; Shanghai Inst. of Optics and Fine Mechanics, Chinese Acad. of Sciences, China*

FB1, Recent Development and New Ideas in the Field of Dispersive Multilayer Optics, ***Volodymyr Pervak****; Ludwig-Maximilians-Univ. München, Germany*

Optical Interference Coatings (OIC)

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Short Courses

Short courses are a wonderful way to enhance your knowledge of the optical field. OIC selects experts in their fields to provide you with an in-depth look at intriguing topics. The courses are designed to increase your knowledge of a specific subject while offering you the experience of knowledgeable teachers. An added benefit is the availability of continuing education units (CEUs).

CEUs are awarded to each participant who successfully completes the short course. The CEU is a nationally recognized unit of measure for continuing education and training programs that meet established criteria. To earn CEUs, a participant must complete the CEU credit form and course evaluation and return it to the instructor at the end of the course. CEUs will be calculated and certificates will be mailed to participants.

- Tuition for short courses is a separate fee, and advance registration is recommended: the number of seats is limited.
- Short courses will sell out quickly! There will be no waiting list.
- Short course materials are not available for purchase.

Schedule

June 6, 2010, 8:00 a.m.–12:00 p.m.

SC227: Understanding the Optical Properties of Optical Coating Materials, *Olaf Stenzel; Fraunhofer IOF, Germany*

Course Description
This is an intermediate level course for people who would like to become familiar with fundamentals and practical modelling of the optical properties of optical materials with emphasis on coating materials. Focus is made on interference coating materials, but selected data on semiconductor films or organic layers complete the subject. The discussed examples span the field from traditional textbook material to rather recent results and modern developments.

The course provides attendees with theoretical knowledge on the basic properties of linear optical constants. It consists of three parts. In the first (more formal) part, starting from Maxwell‘s equations, general properties of the optical constants are introduced and discussed basing on fundamental principles of the interaction of light with matter, including causality and Kramers-Kronig-relations. The second (and more applicative) main part of the course concentrates on the derivation and application of classical dispersion models to describe the optical behaviour of isotropic thin film optical materials. Examples include metals and dielectrics as well as material mixtures. The short third part completes the description with a concise survey of the semiclassical treatment of optical coating properties.

Some basic knowledge on higher mathematics (differential and integral calculus as well as vector algebra) is presumed as well as basic knowledge on classical electrodynamics. Some knowledge on solid state physics and quantum mechanics is of use, but not necessary to benefit from the course.

Benefits and Learning Objectives
This course should enable you to:

- Discuss the optical constants of any material basing on fundamental physical principles;
- Identify a suitable dispersion model applicable to the material under investigation in practice;
- Calculate the optical constants of material mixtures, among them porous layers and systems with metal island films;
- Discover correlations between optical and mechanical layer properties; and

- Simulate linear optical constants at both classical and semi-classical levels.

Intended Audience
This course is of use for anyone who needs to compute thin film optical constants for either design or characterization tasks. It is addressed to newcomers and experts on technical and high school level and to engineer and science students of higher terms.

Biography
Olaf Stenzel received his Diplom Physiker in 1986 from Moscow State University, his Dr. rer. nat. in 1990 and his Dr. habil in 1999, both from the University of Technology in Chemnitz, Germany. He has over 6 years teaching experience as a university lecturer. In 2001, he changed to the Optical Coating Department at the Fraunhofer Institute of Applied Optics and Precision Engineering in Jena, Germany. At present he is the Group Manager for NIR- and VIS-Coatings at this department. The combination of university teaching until 2001 with more applicative research work at the Fraunhofer Institute defines the individual content and style of the offered short course.

Olaf Stenzel has authored and co-authored more than 50 scientific papers, mainly in the field of thin film spectroscopy and authored two textbook on thin film optics.

SC297: From Understanding the Growth Process to Judicious Control of the Performance of Optical Film Systems, *Ludvik Martinu; Ecole Polytechnique Montreal, Canada*

Course Description
Advances in optics, optoelectronics, and photonics strongly depend on the development of new deposition processes and film materials for optical film systems such as optical filters, waveguides, and optical microelectromechanical systems. Besides appropriate control of the optical constants (refractive index, extinction coefficient and optical loss), the requirements include enhanced mechanical performance, long-term environmental stability, and specific functional characteristics (electrical conductivity, gas or vapor permeation, hydrophobicity or hydrophilicity, etc.). Such film properties strongly depend on the film composition and microstructure that are dictated by the physical and chemical surface reactions during the film growth.

This course provides the most recent background and understanding of two important aspects necessary for further advances in optical coatings:

1. Effect of energetic ion- and photon-induced reactions at the surface during the film growth by different complementary techniques including ion (beam) assisted deposition (IAD or IBAD), balanced and unbalanced magnetron sputtering (BMS and UMS), dual ion beam sputtering (DIBS), filtered cathodic arc deposition (FCAD), and plasma-enhanced chemical vapor deposition (PECVD), while concentrating on the most recent pulsed-discharge processes and time- and spatially-resolved diagnostic methods. This includes the principles and capabilities of the microstructural characterization methods suitable for materials assessment, for process optimization and for reverse engineering.

2. Metrology of the mechanical, tribological and other functional properties of optical films and their long term stability under various thermal, radiative and environmental conditions. It makes a link between the optical, mechanical and other characteristics, the film microstructure and the film growth mechanisms, allowing one to better perform film system optimization. This is illustrated by numerous practical examples of filter performance with discrete and graded designs ranging from antireflective coatings and complex optical filters to the optical coatings on plastics.

Benefits and Learning Objectives
This course should enable you to:

- Describe the principles of different complementary deposition techniques of optical films and discuss their advantages for specific applications.
- Explain the role surface reactions in the formation thin film microstructure.
- Determine and discuss the relationship between the microstructure and the films optical, mechanical and other functional properties.
- Summarize different testing methods for the assessment of the microstructure and of the optical and mechanical properties, and compare and explain their reliability.
- Determine and justify the choice of specific deposition methods, thin film materials and characterization techniques for particular optical applications including multilayer and graded layer optical filters.

Intended Audience
This course is intended for technologists, students, researchers, as well as managers who wish to obtain a condensed overview of the processes, materials and characterization techniques related to the fabrication of optical coatings, optical film systems, and to their optimization, as illustrated by numerous examples from laboratory and industrial practice. Familiarity of the participants with basic concepts of physics and engineering would be helpful but not necessary.

Biography
Ludvik Martinu is Professor at École Polytechnique de Montréal, Head of its Department of Engineering Physics, Associate Director of the Thin Film Research Center, founder and director of the Functional Coating and Surface Engineering Laboratory, Vice-president of the SVC, and organizer and co-organizer of numerous international symposia. His main research interest is surface engineering and the physics and technology of thin films for optics, photonics, aerospace, biomedical and other applications. His activities resulted in more than 300 publications and 6 patents.

SC299: Design, Pre-Production Analysis, Computational Manufacturing and Reverse Engineering of Optical Coatings,
Alexander V. Tikhonravov; Res. Computing Ctr., Moscow State Univ., Russian Federation

Course Description
In this course the most efficient optical coating design techniques are discussed. Modern design approaches aimed at constructing sets of theoretical designs with different combinations of principle design parameters (merit function value, number of design layers, design total optical thickness) are considered. It is demonstrated that these design approaches extend opportunities for choosing the most practical design with the best probability of a high manufacturing yield.

The course covers various aspects of the pre-production error analysis of optical coatings. It is demonstrated how this analysis enables one to reveal the most critical coatings layers which deposition requires a special attention. Recent results connected with the pre-production estimation of thickness errors associated with optical monitoring are observed. It is shown how to use error analysis for a pre-production estimation of production yield.

The course demonstrates an increasingly important role of computational manufacturing of optical coatings (computer simulation of deposition and monitoring processes). It is shown how computational manufacturing experiments can be used for selecting optimal monitoring strategies and choosing designs with the best probability of high production yield. In connection with this topic specification of various monochromatic monitoring strategies is discussed.

The course presents main ideas of reverse engineering (post-production characterization) of manufactured optical coatings. It is discussed how reverse engineering can be used for calibrating of monitoring devices and eliminating of systematic manufacturing errors. Raising production yields with the help of the on-line correction of monitoring and deposition processes is considered.

Benefits and Learning Objectives
This course should enable you to:

- Identify and test modern design approaches that are most suitable for solving your specific design problems;
- Perform a pre-production error analysis of optical coatings in order to reveal the most critical coatings layers which deposition requires a special attention, estimate a cumulative effect of thickness errors;
- Compare various monitoring strategies and perform computational manufacturing experiments for selecting optimal monitoring strategies and choosing designs with the best probability of high production yield; and
- Investigate main reasons for the degradation of the spectral performance of manufactured coatings and find ways to improve the production yield.

Intended Audience
The intended audience includes designers of optical coatings, production engineers and technicians. The background required is a general understanding of what are thin films and optical coatings. Prior knowledge of design and evaluation techniques is not essential because the course will cover basic ideas and practical aspects of modern design approaches and new topics related to choosing the most practical design and maximizing the production yield.

Biography
Alexander Tikhonravov is a Professor of Theoretical Physics and the Director of the Research Computing Center of Moscow State University. He has received his PhD degree and Doctor of Sciences degree from Moscow State University. He has authored nearly 300 publications, among them the book "Basics of Optics of Multilayer Systems". Alexander Tikhonravov is the inventor of the needle optimization technique, a universal technique for the design of optical coatings. He was a course instructor at the OIC 1995, OIC 1998, OIC 2001, OIC 2004 and OIC 2007 meetings.

June 6, 2010, 1:00 p.m.–5:00 p.m.

SC295: Plastics Optics - Coatings and Antireflective Structures, *Ulrike Schulz; Fraunhofer IOF, Germany*

Course Description
Modern optical applications need solutions for the antireflective equipment of polymer surfaces. The problems for coating comprise thermal limitations, incompatible mechanical properties of coating and substrate materials and the interaction between polymers and plasma. This course provides attendees with a basic knowledge of transparent polymer materials for optical applications. The course concentrates on polymer material properties, coating processes suitable for polymers, interactions between polymers and plasma, adhesion, stress, interference layers for polymers, hard coatings, top-layers to control the wettability and evaluation and testing procedures.

The course especially concentrates on antireflection coatings and antireflective sub-wavelength structures. The potential to produce antireflective interference coatings is shown for plasma-assisted vacuum deposition techniques as well as for sol-gel wet chemical processes. In addition, various procedures to obtain antireflective structures on polymers will be explained. Special solutions are discussed for acrylic, polycarbonate and cycloolefin polymers.

Benefits and Learning Objectives
This course should enable you to:

- Specify the best suitable polymer materials for your application;
- Understand the special behavior of polymers during vacuum coating processes;
- Evaluate different techniques for antireflection of polymer surfaces; and
- Define suitable characterization tools and testing procedure for your plastic optics.

Intended Audience
This course is of use for anyone who would like to get an overview about the problems connected with coating plastics. It is addressed to newcomers and experts on technical and high school level and to engineer and science students of higher terms.

Biography
Dr. Ulrike Schulz is chemist and group manager at the optical coating department of Fraunhofer IOF in Jena, Germany. She has been involved in optical coating on plastics for more than 15 years. She has published numerous papers and patents and is author of the book chapter “Coating on plastics” (published in “Handbook of plastic optics”, S. Bäumer, ed., Wiley-VCH, 2005 and 2010).

SC298: Manufacture of Precision Evaporative Coatings, *James B. Oliver; Univ. of Rochester, USA*

Course Description
Evaporation is an ideal process for the deposition of optical coatings, providing flexibility in source materials, scalability for large-aperture substrates, relatively low film stress, and high laser damage resistance. While evaporation is a “well-understood” and “basic” deposition process, a deeper level of understanding provides the ability to produce coatings of significantly greater precision and performance. If the fundamental requirements of a coated optical component are spectral/photometric performance, sufficiently flat surface figure, environmental resistance and/or stability, and laser damage resistance, then it is important to control the process variables that influence these requirements. Through sufficient process control of layer endpoint determination, film thickness uniformity, thin-film material structure and vacuum chamber conditions, it is possible to produce extremely high performance evaporative coatings.

The goal of this course is to provide detailed information on how to establish and improve evaporative coating processes for precision optical coatings. Design considerations for coating chambers, such as source placement, substrate fixturing, control of film thickness uniformity, and thickness monitors will be discussed. Trade-offs in the selection of source materials, means of controlling film structure, and the influence on the performance of the coated component will be considered. Process details will be approached with a focus on practicality; film properties must be measurable and system designs must be practical and cost-effective. These process concepts are readily implemented in standard evaporation systems, providing significant improvements in existing coating facilities.

Benefits and Learning Objectives
This course should enable you to:

- Determine proper evaporation source placement in a coating chamber;
- Evaluate different types of substrate fixturing and rotation systems;
- Understand how to calculate film thickness uniformity;
- Understand the impact of film stress and how to control it;
- Realize the importance of the deposited film structure and its influence on film properties; and
- Better control evaporation processes for high-precision spectral or photometric performance.

Intended Audience
This course is intended for engineers and scientists who develop or manufacture optical coatings using evaporation processes.

Material will be presented at an intermediate to advanced level, though many topics will be well-suited for anyone establishing or refining evaporation deposition processes.

Biography
James Oliver earned bachelor's and master's degrees in optics from the University of Rochester Institute of Optics, and he has been working in optical thin films since 1992. He is currently a research engineer in the Optical Manufacturing group at the University of Rochester Laboratory for Laser Energetics (LLE), where he develops and manufactures optical coatings for large-aperture, high-fluence laser applications. He served as the OSA Thin Films Chair from 2003-2005, co-chair of the SPIE “Advances in Thin Film Coatings for Optical Applications“ in Denver, CO (2004), and has been a member of the Program Committee for the Optical Interference Coatings Conference since 2007. He gives short courses as a part of the annual summer school and is a lecturer in Optical Interference Coating Design at the University of Rochester.

SC348: Physics and Technology of Optical Thin Film Deposition, *Norbert Kaiser; Fraunhofer IOF, Germany*

Course Description
This course is of use for anyone who needs to learn how optical coatings are used to tailor the optical properties of surfaces. After an introduction about the fundamentals of optical coatings and vacuum technologies, the participants should learn to calculate the optical properties of uncoated and coated surfaces. Based on this, typical design and deposition concepts and a survey of current applications will be presented.

Benefits and Learning Objectives
This course should enable you to:

- Define optical material properties and review types of optical coatings;
- Describe theory of interference films and apply rules of thumb for quick overview of performance;
- Explain fundamentals of vacuum technologies in terms of performance and costs;
- Identify basic structure related film properties;
- Discuss thin film characterization methods and practical evaluation techniques;
- Test modern design concepts with commercial software;
- Discuss industrial needs in optical coating technologies vs. performance and costs; and
- Discuss international trends.

Intended Audience
This course is of use for anyone who needs to learn how optical coatings are used to tailor the optical properties of surfaces. It is addressed to both newcomers and experts alike. The course will provide a comprehensive view of the field while reflecting the changing nature of optical coatings. A Summary Review of the entire field are presented in logical order and completed by extensive industrial research background.

Biography
Norbert Kaiser heads the Optical Thin Film Department and is deputy director of the Fraunhofer Institute Applied Optics and Precision Engineering in Jena. He was instructor Short Course - SVC 2003 Optical Coatings for the DUV-, VUV-, EUV-, and C-316 Soft X-ray Spectral Region, San Francisco 2003 and Tucson 2004. He is Professor for Optical Coatings and teaches at the Technical University of Jena, Germany.

SC349: Space Optics, *Michael L. Fulton; Ion Beam Optics Inc., USA*

Course Description
Optical coated components play a vital role in the US space program. It is the intention of this course to explore specific design and production challenges encountered by optical engineers working on space systems. Both in man-flight and remote sensing space applications there is an explicit requirement that the optical engineer to produce highly specialized and environmentally stable coating designs.

Starting with single layer coatings for space solar cell cover glass, this course will progress through multi-layer anti-reflection coatings used on the Space Shuttle and International Space Station windows. Complex remote sensing instrumentation requires specialized optical coatings–a delineation of some of these will be presented. Concomitant with the demand for advanced space coatings has been a rapid development in thin-film deposition technologies. Some of the most effective deposition technologies, used for producing modern optical coatings for space applications, will be explored.

Finally, we examine the optical coating requirements for some recent and future space missions. This will include the Kepler mirror coating program, supporting the mission of looking for earth-like planets in our galaxy. In conclusion, we will discuss the possible use of optical coating technology to deposit coatings in the vacuum of space for future Luna and Mars missions.

Benefits and Learning Objectives
This course should enable you to:

- Compare thin-film deposition technologies and their applicability for coating space optical components;
- Define the criteria for developing a specification for an optical coating used in the space environment;
- Describe the approach that a thin-film optical coating designer would use to producing an advanced space coating;
- Determine the coating design type that would be useful for difference space optical requirements;
- Discuss the environmental requirements of the pre-launch, launch, and orbit that place particular stress on coated space optics;
- Explain how energetic deposition techniques increase the durability and optical performance of coated space optics;
- Identify filter types, and how they are used in space optical applications, such as anti-reflection; band pass; edge filters; high reflectors; etc.; and
- Summarize how space coating technology was used on past programs and what areas of future space work will require even more advanced thin-film depositions.

Intended Audience

This new course is intended for optics professionals and others who are interested in the design and production of space mission optical coatings. It is envisaged that the course content will be accessible to students as well as engineering professionals.

Biography

Starting with Optical Coating Laboratory Inc. (OCLI) Michael L. Fulton worked on coatings for a variety of space applications: solar cell coverglass; Space Shuttle windows; Galileo IR filters (Jupiter mission); GOES IR filters (weather satellites); remote sensing; and others. He pioneered Ion Assisted Deposition (IAD) technology for the production of advanced space coatings. At the Boeing High Technology Center he developed the UV protection coatings on silicone Fresnel lenses for space solar concentrators. After returning from Singapore, he joined ZC&R where he designed and produced the window coatings for the International Space Station. In 2000 he joined the Rockwell Science Center where he developed the hyper-spectral filter coatings used on the Mars Reconnaissance Orbiter. In 2003 he started Ion Beam Optics Inc., where the Phase II AFRL SBIR contract for developing radiation resistant coatings for space solar cell coverglass was successfully completed. Recently, he joined Surface Optics Corp where the Kepler mirror and other advanced space coatings are produced.

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Optical Interference Coatings Agenda of Sessions		
Sunday, June 6		
7:00 a.m.–5:00 p.m.	Registration Open	Grand Ballroom Foyer
8:00 a.m.–12:00 p.m.	SC227 Understanding the Optical Properties of Optical Coating Materials; SC297 From Understanding the Growth Process to Judicious Control of the Performance of Optical Film Systems; SC299 Design, Pre-Production Analysis, Computational Manufacturing and Reverse Engineering of Optical Coatings	Rooms announced on-site
1:00 p.m.–5:00 p.m.	SC295 Plastics Optics - Coatings and Antireflective Structures; SC349 Space Optics; SC298 Manufacture of Precision Evaporative Coatings; SC348 Physics and Technology of Optical Thin Film Deposition	
6:00 p.m.–7:30 p.m.	Welcome Reception	Kiva Patio
Monday, June 7		
7:00 a.m.–5:00 p.m.	Registration Open	Grand Ballroom Foyer
8:10 a.m.–8:20 a.m.	Opening Remarks	Grand Ballroom Salon B&C
8:20 a.m.–8:30 a.m.	David Cushing Memorial Talk	Grand Ballroom Salon B&C
8:30 a.m.–9:35 a.m.	MA • Deposition	Grand Ballroom Salon B&C
9:35 a.m.–10:05 a.m.	Coffee Break / Exhibits	Grand Ballroom Foyer
10:05 a.m.–11:10 a.m.	MB • Manufacturing Contest and Large Area Coatings	Grand Ballroom Salon B&C
11:10 a.m.–12:00 p.m.	PMAB • Poster Session I	Grand Ballroom Salon A
12:00 p.m.–1:30 p.m.	Lunch	Kiva Ballroom
1:30 p.m.–2:40 p.m.	MC • Coatings for Solar Applications	Grand Ballroom Salon B&C
2:40 p.m.–3:10 p.m.	Coffee Break / Exhibits	Grand Ballroom Foyer
3:10 p.m.–4:05 p.m.	MD • UV	Grand Ballroom Salon B&C
4:05 p.m.–5:00 p.m.	PMCD • Poster Session II	Grand Ballroom Salon A
5:00 p.m.–6:30 p.m.	Evening Session	Grand Ballroom Salon B&C
Tuesday, June 8		
7:30 a.m.–5:00 p.m.	Registration Open	Grand Ballroom Foyer
8:10 a.m.–8:20 a.m.	Alfred Thelen Memorial Talk	Grand Ballroom Salon B&C
8:20 a.m.–9:35 a.m.	TuA • Design I and Theory	Grand Ballroom Salon B&C
9:35 a.m.–10:05 a.m.	Coffee Break / Exhibits	Grand Ballroom Foyer
10:05 a.m.–11:05 a.m.	TuB • Design II and Applications I	Grand Ballroom Salon B&C
11:05 a.m.–12:00 p.m.	PTuAB • Poster Session III	Grand Ballroom Salon A
12:00 p.m.–1:30 p.m.	Lunch	Kiva Ballroom
1:30 p.m.–2:45 p.m.	TuC • Optical Monitoring	Grand Ballroom Salon B&C
2:45 p.m.–3:15 p.m.	Coffee Break / Exhibits	Grand Ballroom Foyer
3:15 p.m.–4:35 p.m.	TuD • Deposition Control and Applications	Grand Ballroom Salon B&C
4:35 p.m.–5:30 p.m.	PTuCD • Poster Session IV	Grand Ballroom Salon A
5:30 p.m.–6:30 p.m.	Evening Session	Grand Ballroom Salon B&C

Wednesday, June 9		
8:00 a.m.–5:00 p.m.	Registration Open	Grand Ballroom Foyer
8:20 a.m.–9:40 a.m.	WA • Nano- and Microstructure	Grand Ballroom Salon B&C
9:40 a.m.–10:10 a.m.	Coffee Break / Exhibits	Grand Ballroom Foyer
10:10 a.m.–11:10 a.m.	WB • Photonic Structure and Plasma-Polymerized Films	Grand Ballroom Salon B&C
11:10 a.m.–12:00 p.m.	PWAB • Poster Session V	Grand Ballroom Salon A
12:00 p.m.–1:30 p.m.	Lunch	Kiva Ballroom
1:30 p.m.–2:35 p.m.	WC • Polarization	Grand Ballroom Salon B&C
2:35 p.m.–3:05 p.m.	Coffee Break / Exhibits	Grand Ballroom Foyer
3:05 p.m.–4:25 p.m.	WD • Coating Stress	Grand Ballroom Salon B&C
4:25 p.m.–5:20 p.m.	PWCD • Poster Session VI	Grand Ballroom Salon A
6:00 p.m.–7:30 p.m.	Conference Reception	Poolside
Thursday, June 10		
8:00 a.m.–5:00 p.m.	Registration Open	Grand Ballroom Foyer
8:20 a.m.–9:35 a.m.	ThA • Materials	Grand Ballroom Salon B&C
9:35 a.m.–10:05 a.m.	Coffee Break	Grand Ballroom Foyer
10:05 a.m.–10:20 a.m.	ThB • Optics at the University of Rochester	Grand Ballroom Salon B&C
10:20 a.m.–11:05 a.m.	ThC • Measurement Contest and Measurement I	Grand Ballroom Salon B&C
11:05 a.m.–12:00 p.m.	PThAC • Poster Session VII	Grand Ballroom Salon A
12:00 p.m.–1:30 p.m.	Lunch	Kiva Ballroom
1:30 p.m.–2:40 p.m.	ThD • Measurement II	Grand Ballroom Salon B&C
2:40 p.m.–3:10 p.m.	Coffee Break	Grand Ballroom Foyer
3:10 p.m.–4:10 p.m.	ThE • Measurement III	Grand Ballroom Salon B&C
4:10 p.m.–4:45 p.m.	PThDE • Poster Session VIII	Grand Ballroom Salon A
4:45 p.m.–10:00 p.m.	Kitt Observatory Tour (by ticket only)	
Friday, June 11		
8:00 a.m.–12:00 p.m.	Registration Open	Grand Ballroom Foyer
8:20 a.m.–9:40 a.m.	FA • High Power and Laser Damage	Grand Ballroom Salon B&C
9:40 a.m.–10:10 a.m.	Coffee Break	Grand Ballroom Foyer
10:10 a.m.–11:10 a.m.	FB • Ultrafast	Grand Ballroom Salon B&C
11:10 a.m.–11:15 a.m.	Closing Remarks	Grand Ballroom Salon B&C
11:15 a.m.–12:00 p.m.	PFAB • Poster Session IX	Grand Ballroom Salon A
12:00 p.m.–1:30 p.m.	Lunch	Kiva Ballroom

• Sunday, June 6 •

Grand Ballroom Foyer
7:00 a.m.–5:00 p.m.
Registration Open

8:00 a.m.–12:00 p.m.
SC227 Understanding the Optical Properties of Optical Coating Materials
SC297 From Understanding the Growth Process to Judicious Control of the Performance of Optical Film Systems
SC299 Design, Pre-Production Analysis, Computational Manufacturing and Reverse Engineering of Optical Coatings

1:00 p.m.–5:00 p.m.
SC295 Plastics Optics - Coatings and Antireflective Structures
SC349 Space Optics
SC298 Manufacture of Precision Evaporative Coatings
SC348 Physics and Technology of Optical Thin Film Deposition

Kiva Patio
6:00 p.m.–7:30 p.m.
Welcome Reception

• Monday, June 7 •

Grand Ballroom Foyer
7:00 a.m.–5:00 p.m.
Registration Open

8:10 a.m.–8:20 a.m.
Opening Remarks
Christopher Stolz; *Lawrence Livermore Natl. Lab, USA.*

8:20 a.m.–8:30 a.m.
David Cushing Memorial Talk
H. Angus Macleod; *Thin Film Ctr. Inc., USA.*

MA • Deposition

Grand Ballroom Salon B&C
8:30 a.m.–9:35 a.m.
Alexander V. Tikhonravov; Res. Computing Ctr., Moscow State Univ., Russian Federation, Presider
James B. Oliver; Univ. of Rochester, USA, Presider

MA1 • 8:30 a.m. **Invited**
Some Current Topics in Optical Coatings, *H. Angus Macleod*; *Thin Film Ctr. Inc., USA.* We discuss some of the topics currently being pursued in optical coatings. These include topics such as performance limits, coatings for ultrafast applications, baking, sculptured or anisotropic coatings, surface plasmons, and metamaterials.

MA2 • 8:55 a.m.
Thermal Noise Minimization in Optical Coatings, *Rand D. Dannenberg*; *LIGO Coating Working Group, USA.* We discuss the importance of thermal noise in optical coatings for gravitational wave detectors, and approaches towards minimizing it with design and material modifications. Experimental and *ab initio* computational materials modeling results will be highlighted.

MA3 • 9:00 a.m.
Towards a New Generation of Low Loss Mirrors for the Advanced Gravitational Waves Interferometers, *Laurent Pinard*, *Benoit Sassolas, Raffaele Flaminio, Danièle Forest, Aline Lacoudre, Christophe Michel, Jean-Luc Montorio, Nazario Morgado; Lab de Matériaux Avancés, CNRS, France.* New generation of advanced interferometer needs fused silica mirrors having better optical and mechanical properties. This paper describes the way to reduce the IBS coating absorption (1064 nm) and to improve the layer thickness uniformity.

MA4 • 9:05 a.m.
Improving the Abrasion Resistance of Organosilane-Modified Sol-Gel Coatings for High-Peak-Power Laser Applications, *Kenneth L. Marshall*, *Eric Glowacki, Christopher Sileo, Leela Chockalingam, Jason Lee, Vince Guiliano, Amy Rigatti; Lab for Laser Energetics, Univ. of Rochester, USA.* Contamination-resistant, silane-modified sol-gel AR-coated optics are now deployed in many areas of both OMEGA and OMEGA EP. Modification of these sol-gel coatings with other reactive chemical agents can also significantly enhance their abrasion resistance.

MA5 • 9:10 a.m.
Improved Resistance for Antireflective Coatings on Sapphire, *Christoph Gödeker*, *Ulrike Schulz, Norbert Kaiser; Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* Antireflective coatings on sapphire were optimized by variation of the coating design, the total thickness and the highly refraktive material used. The coatings were characterized with a focus on their mechanical properties.

MA6 • 9:15 a.m.
Design and Production of Bandpass Filters with Steep Transmittance Slopes, *Alexander V. Tikhonravov*[1], ***Michael K. Trubetskov***[1], *Ivan V. Kozlov*[1], *Valery G. Zhupanov*[2], *Evgeny V. Klyuev*[2]; [1]*Res. Computing Ctr., Moscow State Univ., Russian Federation,* [2]*Scientific Res. Inst.ion "Lutch", Russian Federation.* The design approach originally developed for WDM filters is applied for designing wide bandpass filters. Obtained multicavity filters can be successfully manufactured using turning point optical monitoring combined with quartz crystal monitoring.

MA7 • 9:20 a.m.
UV- and VIS Filter Coatings by Plasma Assisted Reactive Magnetron Sputtering (PARMS), *Michael Scherer*, *Juergen Pistner, Walter Lehnert; Leybold Optics GmbH, Germany.* The advantage of PARMS for the manufacturing of high performance low loss coatings is demonstrated with UV- and VIS band pass filter based on HfO_2 respectively Nb_2O_5 and SiO_2.

MA8 • 9:25 a.m.
Properties of Ge and GeO_x Thin Films Deposited by Magnetron Sputtering, *Marius Grigonis*, *Markus K. Tilsch, Karen D. Hendrix; JDS Uniphase, USA.* Optical properties of pulsed DC magnetron sputtered Ge and GeO_x layers are reported. Complex multilayer infrared bandpass filters were successfully fabricated. However, these coatings exhibit severe environmental durability issues which may limit their applications.

MA9 • 9:30 a.m.
Design and Manufacture of Metal-Dielectric Long Wavelength Cut-Off Filters, *Penghui Ma*, *Fengchen Lin, George J. A. Dobrowolski; Natl. Res. Council Canada, Canada.* The design and manufacture of a long wavelength cut-off filter is presented. The filter has a pass band that covers the entire visible range. Its stop band extends well into the infrared range.

Grand Ballroom Foyer
9:35 a.m.–10:05 a.m.
Coffee Break/Exhibits

MB • Manufacturing Contest and Large Area Coatings

Grand Ballroom Salon B&C
10:05 a.m.–11:10 a.m.
Norbert Kaiser; Fraunhofer Inst. für Angewandte Optik und Feinmech, Germany, Presider
Jennifer Kruschwitz; JK Consulting, USA, Presider

MB1 • 10:05 a.m. **Invited**
2010 OSA Topical Meeting on Optical Interference Coatings: Manufacturing Problem, *George Dobrowolski*, *Li Li; Natl. Res. Council Canada, Canada.* The problem selected for this conference was a step filter, which will display the manufacturing capabilities available to the participants and is not unlike problems that need to be solved in the telecom industry.

MB2 • 10:35 a.m.
Optimization of Coating Uniformity in an Ion Beam Sputtering System Using a Modified Planetary Rotation Method, *Mark Gross, Svetlana Dligatch, **Anatoli Chtanov**; CSIRO Materials Science and Engineering, Australia.* A modified planetary rotation system has been developed to obtain high uniformity optical coatings on large substrates in an ion beam sputter coater. Peak-to-valley uniformities ~ 0.3% on 400 mm diameter substrates have been achieved.

MB3 • 10:40 a.m.
Large-Area Uniformity in Evaporation Coating through a New Form of Substrate Motion, *Feiling Wang*, *Ronald Crocker, Ralph Faber; Vacuum Process Technology LLC, USA.* To achieve a high degree of thickness uniformity in evaporation coating, a new manner of surface rotation is introduced. The motion results in superior thickness uniformity over a large area compared to planetary rotation.

MB4 • 10:45 a.m.
Advanced Large Area Deposition Technology Used on Kepler Space Telescope Primary Mirror, *David Sheikh*, *Steve Connell, Samuel Dummer, Michael Fulton; Surface Optics Corp., USA.* A large area deposition technology provides the capability for producing uniform thin-film coatings on substrates up to 2.1 meters in diameter. This technology successfully coated the Kepler Space Telescope primary mirror.

MB5 • 10:50 a.m.
Future of Advanced Large Area Deposition Technology for Space and Astronomical Applications, *Michael Fulton*, *David Sheikh, Steve Connell, Samuel Dummer; Surface Optics Corp., USA.* The large area deposition technology (3.3 meter dia.), used to produce the Kepler Space Telescope primary mirror, is continuously upgraded. Advanced computer control systems, energetic deposition technologies, and a larger chamber are in the future.

MB6 • 10:55 a.m.
Magnetron Sputtering Deposition Machine for 2-Meter Optics, *Grégory Chauveau[1], Didier Torricini[1], Gilles Borsoni[1], Catherine Grèzes-Besset[1], Dragan Stojcevski[2], **Michel Lequime**[2]; [1]CILAS Marseille, France, [2]Aix-Marseille Univ., France.* A detailed presentation of this new magnetron sputtering machine, the largest in Europe for optical coatings, will be given. The main features of this equipment will be illustrated through a few representative achievements.

MB7 • 11:00 a.m.
Large-Aperture Plasma-Assisted Deposition of ICF Laser Coatings, *James B. Oliver*[1], *Pete Kupinski[1], Amy L. Rigatti[1], Ansgar W. Schmid[1], John C. Lambropoulos[1], Semyon Papernov[1], Alexei Kozlov[1], John Spaulding[1], Daniel Sadowski[1], Roman Chrzan[1], Robert Hand[1], Desmond R. Gibson[2], Ian Brinkley[2], Frank Placido[3]; [1]Univ. of Rochester, USA, [2]Thin Film Solutions, Ltd., UK, [3]Univ. of the West of Scotland, UK.* Plasma-assisted electron-beam evaporation leads to changes in the crystallinity, density and stresses of thin films. A dual-source plasma system provides stress control of large-aperture, high-fluence coatings used in vacuum for substrates 1 m in aperture.

MB8 • 11:05 a.m.
High Performance Coatings with Large RF Plasma Source, *Harro Hagedorn*, *Holger Reus, Alfons Zöller; Leybold Optics GmbH, Germany.* The performance of a PIAD process with RF-plasma source in a large box coater is investigated in respect to high performance coatings. UV-IR cut and BP-filters with low losses are presented.

PMAB • Poster Session I

Grand Ballroom Salon A
11:10 a.m.–12:00 p.m.

Posters included in this session are:

MA2	**MB2**
MA3	**MB3**
MA4	**MB4**
MA5	**MB5**
MA6	**MB6**
MA7	**MB7**
MA8	**MB8**
MA9	

Kiva Ballroom
12:00 p.m.–1:30 p.m.
Lunch

MC • Coatings for Solar Applications

Grand Ballroom Salon B&C
1:30 p.m.–2:40 p.m.
Douglas Smith; Plymouth Grating Lab, Inc., USA, Presider
Roland Loercher; Carl Zeiss AG, Germany, Presider

MC1 • 1:30 p.m. **Invited**
State of the Art of Photonic Structures for Solar Cells, *Ludovic Escoubas*, *Jean-Jacques Simon, Philippe Torchio, David Duché, Sylvain Vedraine, Wilfried Vervisch, Judikael Le Rouzo, Francois Flory, Guillaume Rivière, Gizachew Yeabiyo, Hassina Derbal; Aix-Marseille Univ., France.* A state of the art on photonic structures such as geometrical configurations, thin-films, gratings, photonic crystals and plasmons in solar cells is presented. Recent results obtained by several research groups are described and discussed.

MC2 • 1:55 p.m.
Real Time Optical Monitoring of Properties of Silicon Thin Film Solar Panels, *George Atanasoff*; *AccuStrata, Inc., Univ. of Maryland, USA.* Optical monitoring of silicon absorbers is performed during deposition inside the chamber during solar panel manufacturing, providing adaptive control of the film quality in real time. Results are presented and benefits of monitoring are demonstrated.

MC3 • 2:00 p.m.
Improvement of Effective Lifetime in Negative Charge Material Deposited by Ion Beam Sputter for C-Silicon Solar Cells, *Sheng-Hui Chen*[1], *Chun-Che Hsu[1], Hung-Ju Lin[1], Chi-Li Yeh[1], Shao-Ze Tseng[1], Chorng-Jye Huang[2]; [1]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [2]DelSolar Co., Inc., Taiwan.* Based on the ion beam sputter deposition, the negative-charge material- aluminum oxynitride has been fabricated to be passivation layer. The effective lifetime of C-silicon solar cell is improved 3 times using the negative-charge material.

MC4 • 2:05 p.m.
Determining Quality of Microcrystal Silicon Thin Films Based on Infrared Absorption Coefficients, *Sheng-Hui Chen*[1], *Hung-Ju Lin[1], Ting-Wei Chang[1], Hsuan-Wen Wang[1], Cheng-Chung Lee[1], Chun-Ming Yeh[2], Yen-Yu Pan[2]; [1]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [2]Photovoltaics Technology Ctr., Industrial Technology Res. Inst., Taiwan.* We proposed the absorption coefficient ratio of (1.4 eV)/ (0.8 eV) as the quality factor of microcrystalline silicon thin films. It is convinced that a proportional relationship is between quality factor and solar cell efficiency.

MC5 • 2:10 p.m.
Enhancing the Optical and Electrical Properties of SnO_2 Films by Plasma Etching Deposition, *Bo-Huei Liao*, *Cheng-Chung Lee, Chien-Cheng Kuo, Ping-Zen Chen; Thin Film Technology Ctr., Dept. of Optics and Photonics, Natl. Central Univ., Taiwan.* Fluorine-doped tin oxide films have been deposited by plasma etching deposition with Sn target. The extinction coefficient is less than $1.5x10^{-3}$ in the range of 400nm to 800nm and the lowest resistitivuty is 1.5×10^{-3} Ω-cm.

MC6 • 2:15 p.m.
The Influence of Hydrogen on the Properties of Al and Ga Doped ZnO Films at Low Temperature, *Meng-Chi Li*, *Chien-Cheng Kuo, Ssu-Hsiang Peng, Sheng-Hui Chen, Cheng-Chung Lee; Natl. Central Univ., Taiwan.* Low resistivity and high transmittance of Al-doped ZnO and Ga-doped ZnO transparent conductive thin films have been achieved by a pulsed DC magnetron sputtering in various hydrogen ambient at low temperature.

MC7 • 2:20 p.m.
Fabrication and Characterization of n-ZnO on Glass by IAD at Low Temperature, *Po Kai Chiu*, *Wen Hao Cho, Hung Pin Chen, Chien Nan Hsiao; Natl. Applied Res. Labs, Taiwan.* The electrical and optical properties of ZnO films were investigated with different IAD powers and partial oxygen pressures. The average transmittance was 83.4% and bulk resistivity was 0.06 Ω-cm at 100°C.

MC8 • 2:25 p.m.
Theoretical Study of a Spectrally Selective Ni-NiO Absorber, *Shuxi Zhao, **Ewa Wäckelgård**; Uppsala Univ., Sweden.* Solar-absorbers of Ni-NiO is evaluated with a method where the effective refractive index has been analyzed to determine the steepness in the transition from low reflectance in the solar wavelength range to high in infrared.

MC9 • 2:30 p.m.
Gradient Coatings by Moving Substrate for Large Scale Production, *Shuxi Zhao*, *Ewa Wäckelgård; Uppsala Univ., Sweden.* Thin film for solar-thermal application was prepared by dc-magnetron reactive sputtering. The gradient composition is produced by moving the substrate through inhomogeneous reaction sputtering zone which has been used for large scale production.

MC10 • 2:35 p.m.
Sunlight Heat Reflection and Co-Utilization from Glass Windows Coatings, *Flavio Horowitz*, *Marcelo B. Pereira; Inst. de Fisica, Univ. Federal do Rio Grande do Sul, Brazil.* A double-glazed solar window is presented that combines a passive heat mirror coating with active control of natural illumination and co-utilization of the reflected infrared for heating or cooling by integration to the building envelope.

Grand Ballroom Foyer
2:40 p.m.–3:10 p.m.
Coffee Break/Exhibits

MD • UV

Grand Ballroom Salon B&C
3:10 p.m.–4:05 p.m.
Michael K. Trubetskov; Moscow State Univ., Russian Federation, Presider
James Rancourt; Consultant, USA, Presider

MD1 • 3:10 p.m. **Invited**
Plasma Assisted Deposition of Metal Fluoride Coatings, *Martin Bischoff*[1,2], *Dieter Gäbler[2], Norbert Kaiser[2]; [1]LINOS Photonics GmbH & Co. KG, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* Most of the common metal fluorides were deposited by plasma-assisted electron beam evaporation. Coatings with high packing density and low extinction coefficient could be produced. The advantages in comparison to conventional deposition techniques are discussed.

MD2 • 3:35 p.m.
Tailored Nanocomposite Coatings for Optics, *Olaf Stenzel*[1], *Steffen Wilbrandt[1], Mark Schürmann[1], Norbert Kaiser[1], Henrik Ehlers[2], Mathias Mende[2], Detlev Ristau[2], Stefan Bruns[3], Michael Vergöhl[3], Markus Stolze[4], Mario Held[5], Hansjörg Niederwald[6], Thomas Koch[6], Werner Riggers[7], Peer Burdack[8], Günter Mark[9], Rolf Schäfer[10], Stefan Mewes[11], Martin Bischoff[11], Markus Arntzen[12], Frank Eisenkrämer[13], Marc Lappschies[14], Stefan Jakobs[14], Stephan Koch[15], Beate Baumgarten[15]; [1]Fraunhofer-Inst. for Applied Optics and Precision Engineering IOF, Germany, [2]Laser Zentrum Hannover e.V., Germany, [3]Fraunhofer-Inst. for Surface Engineering and Thin Films IST, Germany, [4]Umicore Materials AG, Liechtenstein, [5]Bte Bedampfungstechnik GmbH, Germany, [6]Carl Zeiss Jena GmbH, Germany, [7]Laseroptik GmbH, Germany, [8]InnoLight GmbH, Germany, [9]Melec GmbH, Germany, [10]robeko, Germany, [11]Linos Photonics GmbH & Co. KG, Germany, [12]Arcon II Flachglasveredelung GmbH & Co. KG, Germany, [13]Leica Microsystems CMS GmbH, Germany, [14]mso jena Mikroschichtoptik GmbH, Germany, [15]Berliner Glas KGaA Herbert Kubatz GmbH & Co., Germany.* Material mixtures offer new possibilities of synthesizing coating materials with tailored optical and mechanical properties. We present experimental results on mixtures of HfO_2, ZrO_2, and Al_2O_3 pursuing applications in UV coating technology.

MD3 • 3:40 p.m.
Laterally Graded Mo/Si Multilayer for a 5 Steradian EUV Collector, *Marco Perske*, *Hagen Pauer, Sergiy Yulin, Viatcheslav Nesterenko, Mark Schürmann, Torsten Feigl, Norbert Kaiser; Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* The deposition of laterally graded Mo/Si multilayers for EUV collector optics is one of the key challenges to bring EUV Lithography to high volume manufacturing. Coating results of the world's largest EUV collector are presented.

MD4 • 3:45 p.m.
Influence of Substrate Finish and Thin Film Roughness on the Optical Performance of Mo/Si Multilayers, *Marcus Trost*[1,2], *Sven Schröder[1], Torsten Feigl[1], Angela Duparré[1]; [1]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany, [2]Inst. of Applied Physics, Friedrich-Schiller-Univ., Germany.* The angle resolved scattering of Mo/Si multilayers at 13.5 nm is analyzed to separate the influence of substrate finish and intrinsic thin film roughening on the optical properties of Mo/Si multilayers.

MD5 • 3:50 p.m.
Improving the Optical Properties of Al_2O_3 by Plasma Etching Deposition, *Bo-Huei Liao*, *Cheng-Chung Lee; Thin Film Technology Ctr., Dept. of Optics and Photonics, Natl. Central Univ., Taiwan.* Fluorine doped Al_2O_3 films have been deposited by plasma etching deposition of aluminum target with various CF_4/O_2 gas at room temperature. The film coated with 0.243 CF_4/O_2 ratio has best optical properties.

MD6 • 3:55 p.m.
Anti-Reflection Coatings for Silicon Ultraviolet Detectors, *Erika T. Hamden*[1], *Jordana Blacksberg[2], Blake Jacquot[2], Todd Jones[2], Michael Hoenk[2], Matthew Dickie[2], Shouleh Nikzad[2], David Schiminovich[1]; [1]Columbia Univ., USA, [2]Caltech, JPL, USA.* We report on development of antireflective coatings optimized for a telescope detector in a UV spectrograph. We discuss progress in the development of a CCD with theoretical QE greater than 60% from 100 to 300nm.

MD7 • 4:00 p.m.
Evaluation of Optically Finished CaF_2 Windows from Far-Infrared to Vacuum-Ultraviolet, *Jue Wang*, *Michael J. D'lallo, Steven VanKerkhove, Horst Schreiber; Corning Tropel Corp., USA.* CaF_2 windows were evaluated by variable angle spectroscopic ellipsometry and spectrophotometer from far-infrared to vacuum-ultraviolet spectral regions. Effect of surface polishing and cleaning was investigated. Optical constant of CaF_2 was presented from FIR to VUV.

PMCD • Poster Session II

Grand Ballroom Salon A
4:05 p.m.–5:00 p.m.

Posters included in this session are:

MC2	**MD2**
MC3	**MD3**
MC4	**MD4**
MC5	**MD5**
MC6	**MD6**
MC7	**MD7**
MC8	
MC9	
MC10	

Evening Session

Grand Ballroom Salon B&C
5:00 p.m.–6:30 p.m.

LIFE: A Path to Laser Fusion Energy, *Edward I. Moses; LLNL, USA***.** The National Ignition Facility (NIF), the world's largest and most powerful laser system for inertial confinement fusion (ICF) and for studying high-energy-density (HED) science, is now operational and conducting experiments at Lawrence Livermore National Laboratory (LLNL). Demonstration of ignition and thermonuclear burn in the laboratory is a major NIF goal. NIF will achieve this by concentrating the energy from its 192 beams into a mm3-sized target and igniting a deuterium-tritium mix, liberating more energy than is required to initiate the fusion reaction. NIF's ignition program is a national effort managed via the National Ignition Campaign (NIC). Achieving ignition at NIF will demonstrate the scientific feasibility of ICF and will focus worldwide attention on laser fusion as a viable energy option.
A laser fusion-based energy concept that builds on NIF ignition, known as LIFE (Laser Inertial Fusion Engine), is currently under development. LIFE is inherently safe and can provide a global carbon-free energy generation solution in the 21st century. LIFE requires development of advanced technologies such as high-repetition-rate (~10 Hz), high-energy lasers; mass production of targets; and first-wall materials capable of withstanding the high x-ray and neutron fluxes present in the fusion environment.
The talk will discuss recent progress on NIF, NIC and the role of NIF in future energy security and frontier science.

NOTES

• Tuesday, June 8 •

Grand Ballroom Foyer
7:30 a.m.–5:00 p.m.
Registration Open

8:10 a.m.–8:20 a.m.
Alfred Thelen Memorial Talk
Ulf Brauneck; *SCHOTT, Germany*

TuA • Design I and Theory

Grand Ballroom Salon B&C
8:20 a.m.–9:35 a.m.
J. A. Dobrowolski; Natl. Res. Council Canada, Canada, Presider
Cheng-Chung Lee; Natl. Central Univ., Taiwan, Presider

TuA1 • 8:20 a.m. **Invited**
Modern Design Approaches and a New Paradigm of Constructing a Coating Design, ***Alexander V. Tikhonravov****; Res. Computing Ctr., Moscow State Univ., Russian Federation.* Modern design approaches are discussed in the frame of a new design paradigm connected with the choice of a practically optimal design instead of a formally optimal design providing the lowest merit function value.

TuA2 • 8:45 a.m.
Designing Coatings in the Presence of Manufacturing Errors, ***Jonathan R. Birge****[1], Franz X. Kärtner[1], Omid Nohadani[1,2]; [1]MIT, USA, [2]Purdue Univ., USA.* A novel robust optimization algorithm is demonstrated, which attempts to account expected coating errors. Monte Carlo simulations show the robust approach improves manufacturing yields relative to conventional optimization.

TuA3 • 8:50 a.m.
On the Reliability of Computational Estimations Used for Choosing the Most Manufacturable Design, *Alexander V. Tikhonravov, Michael K. Trubetskov,* ***Tatiana V. Amotchkina****; Res. Computing Ctr., Moscow State Univ., Russian Federation.* Using results of the probability theory, we estimate a number of computational experiments required for choosing the most manufacturable design with a sufficient confidence level. Experiments with broadband optical monitoring are used as examples.

TuA4 • 8:55 a.m.
Robust Synthesis of Multilayer Coatings, ***Michael K. Trubetskov****, Alexander V. Tikhonravov; Res. Computing Ctr., Moscow State Univ., Russian Federation.* A new synthesis technique allowing to design a set of robust designs is proposed. Efficiency of this technique is demonstrated using AR coating, hot mirror, and broadband filter design examples.

TuA5 • 9:00 a.m.
Computational Manufacturing Experiments for Choosing Optimal Design and Monitoring Strategy, *Alexander V. Tikhonravov, Michael K. Trubetskov,* ***Tatiana V. Amotchkina****; Res. Computing Ctr., Moscow State Univ., Russian Federation.* Computational manufacturing experiments are used for estimating expected production yields and for choosing the most manufacturable design and respective optimal monochromatic monitoring strategy.

TuA6 • 9:05 a.m.
Estimations of Production Yields for Choosing the Best Practical Design, *Alexander V. Tikhonravov[1],* ***Michael K. Trubetskov****[1], Vladimir Pervak[2]; [1]Res. Computing Ctr., Moscow State Univ., Russian Federation, [2]Ludwig-Maximilians-Univ. München, Germany.* Pre-production estimations of manufacturing yields of several theoretical designs can be used for choosing the most manufacturable design. Practical application of such choice is demonstrated using designs with ramp spectral transmittance.

TuA7 • 9:10 a.m.
Sensitivity Analysis of Optical Coatings Manufacturing by Numerical Experimental Designs, ***Olivier Vasseur****[1], Magalie Claeys-Bruno[2], Michelle Sergent[2], Michel Cathelinaud[3]; [1]ONERA, France, [2]Univ. Paul Cézanne, France, [3]Missions des Ressources et Compétences Technologiques, UPS CNRS, France.* We investigated the manufacturing processes influence on the robustness of filters manufactured by numerical experimental designs. The most critical interactions of layers are identified. The results give clues to improve filters manufacturing against errors effects.

TuA8 • 9:15 a.m.
Speed of Light and Angle of Propagation in an Absorbing Medium, ***William H. Southwell****; Table Mountain Optics, USA.* We show that light travels faster than c as it traverses thin layers of silver and gold and other materials. Also presented is an expression for the real angle of refraction in absorbing media.

TuA9 • 9:20 a.m.
Composite Anti-Reflection Optical Coating with Silver Nanoparticles, ***Sergey G. Moiseev****[1,2]; [1]V.A. Kotelnikov Inst. of Radio Engineering and Electronics of Russian Acad. of Sciences, Ulyanovsk Branch, Russian Federation, [2]Ulyanovsk State Technical Univ., Russian Federation.* It is theoretically shown that thin composite layer comprised of a transparent host and uniformly oriented disc-like silver nanoparticles deposited onto a glass surface can act as an anti-reflection coating.

TuA10 • 9:25 a.m.
Surface Plasmon Interaction With Nano-Defects, ***Raúl García Llamas****; Univ. de Sonora, Mexico.* The interaction between a surface plasmon, excited at a finite grating of period a_r, and a nano-defect, which is located 64λ from the center of the grating, on a metal surface is presented.

TuA11 • 9:30 a.m.
Optical Coatings under Total Internal Reflection: Optimization of the over-Intensity for Sensor Applications, *Césaire N'Diaye[1], Myriam Zerrad[1], Fabien Lemarchand[1], Dominique Ausserre[2], **Claude Amra**[1]; [1]Inst. Fresnel, France, [2]Univ. du Maine, France.* Resonant multilayer coatings are widely used as sensors because they are known to enhance the incident field under very specific conditions. The optimisation, sensitivity and limitations of such structures will be addressed.

Grand Ballroom Foyer
9:35 a.m.–10:05 a.m.
Coffee Break/Exhibits

TuB • Design II and Applications I

Grand Ballroom Salon B&C
10:05 a.m.–11:05 a.m.
Alfons Zoeller, Sr.; Leybold Optics GmbH, Germany, Presider
Flavio Horowitz; Inst. de Fisica, Univ. Federal do Rio Grande do Sul, Brazil, Presider

TuB1 • 10:05 a.m. **Invited**
2010 OSA Topical Meeting on Optical Interference Coatings: Design Problem, ***Karen D. Hendrix**[1], James Oliver[2]; [1]JDS Uniphase, USA, [2]Lab for Laser Energetics, Univ. of Rochester, USA.* Two design problems were posed: a high-temperature solar-selective coating and a near to mid-infrared Fabry-Perot etalon. Forty-nine submissions were received. The winners will be announced and an analysis of the designs will be presented.

TuB2 • 10:35 a.m.
Optimum Phase for Thin Film Synthesis by Fourier Transforms, ***Pierre G. Verly**; Natl. Res. Council Canada, Canada.* An optimum phase is developed for rugate reflector design by a simple Fourier Transformation. Surprisingly good solutions are obtained for arbitrary spectral curves by phase shaping alone.

TuB3 • 10:40 a.m.
Looking outside the Box for Broadband AR Coating Designs, ***Ronald R. Willey**; Willey Optical, Consultants, USA.* Examining spectral regions outside of the band where an antireflection coating is specified can aid in finding optimal design solutions. It is also found that optimal solutions exist only at quantized intervals.

TuB4 • 10:45 a.m.
Identifying Consistent Film Dispersion Data by Online-Spectra and Cross-Check Analysis, ***Marc Lappschies**, Stefan Jakobs, Uwe Schallenberg; mso jena Mikroschichtoptik GmbH, Germany.* A precise identification of the dielectric materials dispersion data involved forming the layer stack is crucial for obtaining satisfactory results utilizing optical broadband monitoring for high precision control of optical thin film filters.

TuB5 • 10:50 a.m.
Measured Properties of Long-Wavelength Cut-Off Filters Based on Critical Angle, ***Yanen Guo**[1], J. A. Dobrowolski[1], Li Li[1], Daniel Poitras[1], Tom Tiwald[2]; [1]Natl. Res. Council Canada, Canada, [2]J. A. Woollam Co., Inc., USA.* Earlier attempts to implement long-wavelength cut-off filters were not very successful. We describe the adjustments in the design and deposition processes that allowed us to obtain filters with a better and more stable performance.

TuB6 • 10:55 a.m.
Minimizing Thermal Emission in the Atmospheric Windows, ***Carl G. Ribbing**, Shuxi Zhao; Uppsala Univ., Sweden.* Thermal emission in the atmospheric windows represent a possibility for radiative exchange with the low temperatures in outer space. We investigate the opportunities for minimizing this by coating BeO with dielectric film of suitable thickness.

TuB7 • 11:00 a.m.
Optical Transmission Filters for Earth Observation: Design and Testing, ***Angela M. Piegari**, Anna Sytchkova, Ilaria Di Sarcina, Salvatore Scaglione; ENEA Optical Coatings Group, Italy.* Very narrow-band transmission-filters as part of an instrument for studying lightning phenomena are described. Their performance must be maintained at an incidence angle of ±5.5 degrees and not influenced by the environmental conditions in Space.

PTuAB • Poster Session III

Grand Ballroom Salon A
11:05 a.m.–12:00 p.m.

Posters included in this session are:

TuA2	**TuB2**
TuA3	**TuB3**
TuA4	**TuB4**
TuA5	**TuB5**
TuA6	**TuB6**
TuA7	**TuB7**
TuA8	
TuA9	
TuA10	
TuA11	

Kiva Ballroom
12:00 p.m.–1:30 p.m.
Lunch

TuC • Optical Monitoring

Grand Ballroom Salon B&C
1:30 p.m.–2:45 p.m.
Li Li; Natl. Res. Council Canada, Canada, Presider
Bruce Perilloux; Coherent Inc., USA, Presider

TuC1 • 1:30 p.m. Invited
An Overview of Optical Monitoring Techniques, *Brian T. Sullivan*, *Graham Carlow; Iridian Spectral Technologies, Canada.* Optical monitoring is a critical factor in ensuring that thin film optical filters can be grown to the desired specification. This paper describes some of the different types of optical monitoring techniques that are employed for different types of filters and outlines some of the difficulties and advantages associated with each method.

TuC2 • 1:55 p.m.
Optical Monitor with Computed Compensation, *William H. Southwell*; *Table Mountain Optics, USA.* This optical monitor uses an analytic reflectance model and fits the thickness error of the previous layer. The computed compensation (current and next layer) may be applied for a wavelength other than the monitor wavlength.

TuC3 • 2:00 p.m.
Does Broadband Optical Monitoring Provide an Error Self-Compensation Mechanism? *Alexander V. Tikhonravov, Michael K. Trubetskov,* ***Tatiana V. Amotchkina****; Res. Computing Ctr., Moscow State Univ., Russian Federation.* Definition of an error self-compensation mechanism associated with direct broadband optical monitoring is proposed and a research approach for studying this effect is developed. Existence of a strong error self-compensation is demonstrated for cold mirrors.

TuC4 • 2:05 p.m.
Dielectric Filter Production with *in situ* Broadband Optical Monitoring, *Othmar Zueger*; *Optics Balzers AG, Liechtenstein.* An *in situ* broadband optical monitoring is used in a magnetron sputtering system for dielectric filter manufacturing. The spectrometer is synchronized with the substrates motion and measures the reflection of the coating during the deposition process.

TuC5 • 2:10 p.m.
Optical Admittance Monitor through a Dynamic Interferometer, *Kai Wu*[1], *Meng-Chi Li[1], James C. Wyant[2], Neal J. Brock[3], Brad Kimbrough[3], Cheng-Chung Lee[1]; [1]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [2]College of Optical Sciences, Univ. of Arizona, USA, [3]4D Technology Corp., USA.* A way to increase the optical monitoring sensitivity in quarterwave stack fabrication by modified optical admittance loci was demonstrated. The optical admittance value was obtained from an *in situ* dynamic interferometer combing with a photodetector.

TuC6 • 2:15 p.m.
Hybrid Process Control for Precision Optics Enhanced by Computational Manufacturing, *Henrik Ehlers*, *Sebastian Schlichting, Carsten Schmitz, Detlev Ristau; Laser Zentrum Hannover e.V., Germany.* Optical broadband monitoring (BBM) and quartz crystal monitoring are merged into an advanced hybrid process control. In addition, an adapted virtual deposition system covering both optical and non-optical monitoring ensures maximum stability and precision.

TuC7 • 2:20 p.m.
Multi-Wavelength Laser Ellipsometer for *in situ* Monitoring of Optical Coatings, *Anatoli Chtanov*, *Svetlana Dligatch, Mark Gross; CSIRO Materials Science and Engineering, Australia.* A multichannel ellipsometer with several multiplexed lasers operating at different wavelengths was developed. It has a number of advantages such as high signal-to-noise ratio, precisely known and stable wavelengths with small linewidths and simple electronics.

TuC8 • 2:25 p.m.
Precision Filter Manufacture Using Direct Optical Monitoring, *Alfons Zöller*[1], *Jonathan Williams[2], Sigrid Hartlaub[1]; [1]Leybold Optics GmbH, Germany, [2]Qioptiq Ltd., UK.* The performance of a box coater with double rotating substrate holders in combination with direct optical monitoring was investigated. The reproducibility and uniformity results of a multilayer system with tight specifications will be presented.

TuC9 • 2:30 p.m.
Integrated Method for Control and Broadband Monitoring of Multilayer Thin Films, *Samuel A. Atarah*, *Andrey Voronov, Shigeng Song, Frank Placido; Univ. of the West of Scotland, UK.* A thin film deposition monitoring system has been developed. The system monitors deposition processes over a broadband spectrum. Compared with quartz crystal monitoring, initial results from the new broadband monitor are stably reproducible.

TuC10 • 2:35 p.m.
Broadband Optical Monitoring Combined with Additional Rate Measurement for Accurate and Robust Coating Processes, *Stephan Waldner*, *Rico Benz, Patrick Biedermann, Allan Jaunzens; Evatec Ltd., Switzerland.* We present a monitoring technique that combines broadband optical monitoring for accurate layer termination with quartz crystal monitoring ensuring the robustness of the process. Results both from sputter and electron beam evaporation tools are shown.

TuC11 • 2:40 p.m.
In situ* Thickness Determination of Multilayered Structures Using Single Wavelength Ellipsometry and Reverse Engineering, *Daniel Rademacher, *Michael Vergöhl; Fraunhofer Inst. for Surface Engineering and Thin Films IST, Germany.* An *in situ* single wavelength ellipsometer system for *in situ* determination of thickness and dispersion was developed, integrated and evaluated using a magnetron sputtering system.

Grand Ballroom Foyer
2:45 p.m.–3:15 p.m.
Coffee Break/Exhibits

TuD • Deposition Control and Applications

Grand Ballroom Salon B&C
3:15 p.m.–4:35 p.m.
Robert Schaffer; Evaporated Coatings, Inc., USA, Presider
François R. Flory; École Centrale Marseille, France, Presider

TuD1 • 3:15 p.m. **Invited**
Cluster Ion Beam Assisted Thin Film Deposition, *Noriaki Toyoda*, *Isao Yamada; Univ. of Hyogo, Japan.* Gas cluster ion beam (GCIB) realizes ultra-low energy ion irradiations and high-density of energy deposition at the near surface. Fluoride films and amorphous carbon films were deposited with GCIB assisted depositions, and film properties and surface planarization effects are discussed.

TuD2 • 3:40 p.m.
Combined *in situ* and *ex situ* Optical Analysis of Fluoride Coatings Deposited by PIAD, *Steffen Wilbrandt*, *Olaf Stenzel, Norbert Kaiser; Fraunhofer-Inst. for Applied Optics and Precision Engineering IOF, Germany.* The combination of *ex situ* and *in situ* spectrophotometry allows getting insight into the depth distribution of optical losses in PIAD coatings. This optical characterization strategy is exemplified in application to fluoride coatings.

TuD3 • 3:45 p.m.
Particle Generation during Pulsed Reactive Magnetron Sputtering of SiO_2 with Cylindrical and Planar Cathodes, *Michael Vergöhl*, *Daniel Rademacher; Fraunhofer Inst. for Surface Engineering and Thin Films, Germany.* SiO_2 layers were deposited by pulsed reactive magnetron sputtering with cylindrical and planar dual magnetrons. The particle density in SiO_2 films deposited at different process parameters is analyzed.

TuD4 • 3:50 p.m.
Online Detection of Ozone in Ion Beam Sputtering, *Carsten Schmitz*, *Henrik Ehlers, Detlev Ristau; Laser Zentrum Hannover e.V., Germany.* The contents of oxygen species are measured in the reactive atmosphere of an ion beam sputtering process. Based on oxygen sensor concepts, a reliable early detection for absorption in TiO_2 layers is studied.

TuD5 • 3:55 p.m.
Application of Indirect Broadband Optical Monitoring for the Production of Three-Line Minus Filters, *Valery G. Zhupanov*[1], *Evgeny V. Klyuev*[1], *Pavel A. Konotopov*[1], *Alexander V. Tikhonravov*[2], *Michael K. Trubetskov*[2], *Ivan V. Kozlov*[2], *Michael A. Kokarev*[2]; [1]*Scientific Res. Inst.ion "Lutch", Russian Federation,* [2]*Res. Computing Ctr., Moscow State Univ., Russian Federation.* Indirect broadband optical monitoring can be successfully applied for the production of three-line minus filters. Pre-coating of witness substrates used to monitor low index layers raises an accuracy of depositions of these layers.

TuD6 • 4:00 p.m.
Characterization and Fabrication of IR Coatings Using Visible-near IR Ellipsometery and Quartz Crystal Monitoring, *Li Li*[1], *Yanen Guo*[1], *Claude Montcalm*[2]; [1]*Natl. Res. Council Canada, Canada,* [2]*Iridian Spectral Technologies, Canada.* Optical constants of ZnSe, Ge, and BaF_2 films in the IR spectral region were measured using an ellipsometer and spectrophotometers. Broadband IR coatings were fabricated by e-beam evaporation with accurate quartz crystal thickness control.

TuD7 • 4:05 p.m.
On Stability of Induced Transmission Filter Design, *Anna Sytchkova*, *Angela Piegari; ENEA, Italy.* An insight to the problem of sensitivity of induced transmission filter (ITF) design to deposition errors is proposed, allowing a reliable deposition of optical devices using the ITF approach.

TuD8 • 4:10 p.m.
Use of Gold Island Films in Design of Reflectors with High Luminosity, *Hrvoje Zorc*, *Martin Lončarić, Jordi Sancho-Parramon, Vesna Janicki; Ruder Boskovic Inst., Croatia.* We describe the optical properties of gold island films embedded between SiO_2 and TiO_2 layers. Plasmonic properties of gold films have been characterized for various combinations of embedded media and used in design of reflectors.

TuD9 • 4:15 p.m.
Broadband Emitters within Multilayer Micro-Cavities: Optimization of the Light Extraction Efficiency, *Michel Lequime*, *Claude Amra; Aix-Marseille Univ., France.* The optimization of broadband planar emitters like small-molecule OLEDs is achieved through a thin-film approach. Resonance conditions and phase dispersion phenomena are theoretically derived and their impact illustrated on various examples.

TuD10 • 4:20 p.m.
Fiber Relative-Humidity Sensor with Farby-Perot Optical Coating as Sensitive Element, *Minghong Yang*, *Yan Sun, Xiaobin Li, Desheng Jiang; Wuhan Univ. of Technology, China.* A fiber-optic relative-humidity sensor composed of Farby-Perot optical coating as sensitive element is proposed and developed. TiO_2 and MgF_2 multilayer is deposited on fiber end-face, and therefore constructs a sensing head with Fabry-Perot structure.

TuD11 • 4:25 p.m.
The Fabrication of Bio-Inspired Chemical Vapor Sensors via Plasma Enhanced Chemical Vapor Deposition, *Jesse O. Enlow*[1,2], *Daniel M. Gallagher*[1], *Hao Jiang*[1,3], *Lawrence L. Brott*[1], *Rachel Jakubiak*[1], *Rajesh R. Naik*[1], *Timothy J. Bunning*[1]; [1]*AFRL, USA,* [2]*UES Inc., USA,* [3]*Materials Science and Technology Applications, USA.* Plasma enhanced chemical vapor deposition (PECVD) of biologically active films is investigated for the fabrication of bio-inspired chemical vapor sensors, due to the ability to fabricate thin films with unique surface chemistries.

TuD12 • 4:30 p.m.
Fabrication of Tunable Daylight Simulator, ***Mei-Ling Lo****, Tsung-Hsun Yang, Cheng-Chung Lee; Thin Film Technology Ctr., Dept. of Optics and Photonics, Natl. Central Univ., Taiwan.* The tunable daylight simulator mainly consists of only few LEDs and a special designed optical thin film filter. This simulator does simulate daylight spectrum of correlated color temperature (CCT) from 4000K to 10000K.

PTuCD • Poster Session IV

Grand Ballroom Salon A
4:35 p.m.–5:30 p.m.

Posters included in this session are:

TuC2	**TuD2**
TuC3	**TuD3**
TuC4	**TuD4**
TuC5	**TuD5**
TuC6	**TuD6**
TuC7	**TuD7**
TuC8	**TuD8**
TuC9	**TuD9**
TuC10	**TuD10**
TuC11	**TuD11**
	TuD12

Evening Session

Grand Ballroom Salon B&C
5:30 p.m.–6:30 p.m.

The Laser at 50: Gain Media, Resonators (Coatings), and Pumping Means, *Robert L. Byer; Stanford Univ., USA.* This year, 50 years since the first demonstration of the laser in May 1960, we celebrate the remarkable advances in laser sources and the very wide range of applications now supported by the laser; once described by the phrase "The laser,a solution looking for a problem." The advances in laser sources could not have happened without corresponding advances in optical coatings. The talk will review, from a laser point of view, the fortunes and misfortunes of optical coatings combined with lasers.

NOTES

• Wednesday, June 9 •

Grand Ballroom Foyer
8:00 a.m.–5:00 p.m.
Registration Open

WA • Nano- and Microstructure

Grand Ballroom Salon B&C
8:20 a.m.–9:40 a.m.
Detlev Ristau; Laser Zentrum Hannover, Germany, Presider
Francisco V. Villa, Sr.; Ctr. de Investigaciones en Optica, Mexico, Presider

WA1 • 8:20 a.m. Invited
Nanoscale Coatings, ***Norbert Kaiser***[1], *Martin Bischoff*[1,2], *Torsten Feigl*[1], *Ulrike Schulz*[1], *Olaf Stenzel*[1]; [1]*Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany,* [2]*LINOS Photonics GmbH & Co., KG, Germany.* Further progress on the manufacture of nanoscale coatings requires control of film-microstructure at the atomic level. Latest results from coatings for EUV- and DUV-lithography, coatings and nanostructures on plastics and balanced-properties coatings will be presented.

WA2 • 8:45 a.m.
Antireflective Coating with Nanostructured Organic Top-Layer, ***Ulrike Schulz****, Norbert Kaiser; Fraunhofer-Inst. for Applied Optics and Precision Engineering, Germany.* The effective refractive index of organic layers can be reduced by plasma etching. Super broadband AR coatings are obtained by combining those artificial low-index layers with conventionally prepared interference stacks.

WA3 • 8:50 a.m.
New Antireflective Coatings with Porous Nanoparticle Layers for Visible Wavelengths, ***Tsuyoshi Murata****, Hitoshi Ishizawa, Akira Tanaka; Nikon Corp., Japan.* Recently, required performance levels of antireflective coatings are becoming higher in technical fields of camera lens. We succeeded in forming antireflective coatings with ultra-low refractive index layers and achieving superior performances by sol-gel method.

WA4 • 8:55 a.m.
A Novel Structure for Omnidirectonal Antireflection Coating on Glass Substrate, *Hui Ye, Jian Xu, Yi Yin,* ***Xu Liu****; Zhejiang Univ., China.* A novel solution-based S2/P/S1/Glass broadband antireflection coating which has a low and omnidirectional reflectance was demonstrated. The additional S2 film immensely improves mechanical properties, while the impact for AR properties is very small.

WA5 • 9:00 a.m.
Simple Modeling of Nanocomposite Optical Coatings with Ag in SiO_2 Monolayers, *Thiago Menegotto, Marcelo B. Pereira, Ricardo R. B. Correia,* ***Flavio Horowitz****; Univ. Federal do Rio Grande do Sul, Brazil.* Optical properties of sputtered nanocomposites with Ag in SiO_2 monolayers were compared to simple modeling based on Kreibig extension of Drude-Lorentz and Maxwell Garnett theory. Agreement was reached around the surface plasmon resonance region.

WA6 • 9:05 a.m.
Apply Cosine-Shape Nanostructured Thin Film in TE Mode Surface Plasmon Resonance, *Yi-Jun Jen,* ***Chia-Feng Lin****, Yan-Pu Li; Dept. of Electro-Optical Engineering, Natl. Taipei Univ. of Technology, Taiwan.* The Cosine-shape nanostructured thin film is fabricated by glancing angle deposition. TE mode surface plasmon wave can be excited successfully by the interface of a metal and a Cosine-shape thin film in the Krestchmann configuration.

WA7 • 9:10 a.m.
Zinc Oxide Column Rod Array Prepared by Inductively Coupled Plasma-Reactive Ion Etching Technology, *Chun-Ming Chang*[1], *Ming-Hua Shiao*[1], *Shr-Jia Chen*[2], *Chuen-Horng Tsai*[2], *Jiann-Shiun Kao*[1], ***Donyau Chiang***[1]; [1]*Instrument Technology Res. Ctr., Natl. Applied Res. Labs, Taiwan,* [2]*Engineering and System Science, Natl. Tsing Hua Univ., Taiwan.* The nano-scale zinc oxide column rod array is produced by ICP-RIE and nano-sphere lithography. The rod diameter of 54nm is realized.

WA8 • 9:15 a.m.
Microstructure and Optical Properties of Al_2O_3 Prepared by Oblique Deposition Using Nanosphere Shell as Templates, ***Wen-Hao Cho***[1], *Chao-Te Lee*[1], *Chih-Chieh Yu*[1], *Chi-Chung Kei*[1], *Da-Ren Liu*[1], *Cheng-Chung Lee*[2]; [1]*Instrument Technology Res. Ctr., Natl. Applied Res. Labs, Taiwan,* [2]*Thin Film Technology Ctr., Natl. Central Univ., Taiwan.* Inclined Al_2O_3 column array was fabricated by using hollow nanosphere template. Birefringence and photonic crystals behavior can be observed in the orderly inclined column array. Compared to substrate without patterns, photonic crystals property was enhanced.

WA9 • 9:20 a.m.
Negative Real Parts of Equivalent Refractive Indices of Silver Nanorod Arrays with Different Thicknesses, *Yi-Jun Jen,* ***Chih-Hui Chen****; Natl. Taipei Univ. of Technology, Taiwan.* Silver nanorod arrays with the thicknesses of 200±5 and 300±5 nm are deposited using glancing angle deposition. The films would exhibit different negative real parts of the equivalent refractive indices at the wavelength 639 nm.

WA10 • 9:25 a.m.
Negative Real Part of Equivalent Refractive Index of a Chevronic Nanostructured Film of Silver, *Yi-Jun Jen,* ***Yu-Hsiung Wang****, Ching-Wei Yu; Natl. Taipei Univ. of Technology, Taiwan.* The chevronic silver film with thickness 230±5 nm is fabricated using bideposition technique. The real part of the equivalent refractive index and the equivalent permeability of the film are negative at the wavelength 639 nm.

WA11 • 9:30 a.m.
Gradient Silver Nanoparticle Layers in Absorbing Coatings--Experimental Study, ***Vesna Janicki****, Jordi Sancho-Parramon, Hrvoje Zorc; Ruđer Bošković Inst., Croatia.* It is shown experimentally that metal island film-based multilayer coatings with gradient in mass thickness of silver nanoparticles have higher absorption than equivalent non-gradient coatings with the same total mass thickness of silver nanoparticles.

WA12 • 9:35 a.m.
Thermal Effect in UV-O_3 Treatment Used for Synthesis of Mesoporous Silica Films, *Yumei Zhu[1], Jun Shen[1],* ***Bin Ma**[2]; [1]Pohl Inst. of Solid Physics of Tongji Univ., Shanghai Key Lab of Special Artificial Microstructure Materials and Technology, China, [2]Dept. of Physics, Inst. of Precision Optical Engineering, Tongji Univ., China.* We synthesized mesoporous silica films via sol-gel method with CTAB as organic template. UV-O_3 treatment was employed to eliminate organic template at different temperatures. The UV-O_3 treated film showed less shrinkage and no significant distortion.

Grand Ballroom Foyer
9:40 a.m.–10:10 a.m.
Coffee Break/Exhibits

WB • Photonic Structure and Plasma-Polymerized Films

Grand Ballroom Salon B&C
10:10 a.m.–11:10 a.m.
James Barrie; The Aerospace Corp., USA, Presider
Chang Kwon Hwangbo; Inha Univ., Republic of Korea, Presider

WB1 • 10:10 a.m. — Invited
Quantum Confinement and Optical Properties of Nanostructured Thin Films, ***François R. Flory**[1], Yu-Jen Chen[2], Ludovic Escoubas[2], Jean-Jacques Simon[2], Philippe Torchio[2], Vincent Brissonneau[2], David Duché[2], Renaud Bouffaron[2]; [1]École Centrale Marseille, France, [2]Paul Cézanne Univ., France.* Quantum confinement changes material optical properties. We calculate the discrete energy levels of electrons in multiple quantum wells. Results concerning TiO2 nanocrystals in silica are given.

WB2 • 10:35 a.m.
Multi-Level Periodic Leaky-Mode Resonance Elements: Design and Applications, ***Mehrdad Shokooh-Saremi**, Robert Magnusson; Univ. of Texas at Arlington, USA.* Using particle swarm optimization, we design new reflectors and polarizers exhibiting flat spectral bands that are extraordinarily wide. The designed three-level broadband reflector and polarizer show bandwidths of 740 nm and 300 nm, respectively.

WB3 • 10:40 a.m.
Fabrication of Three Dimensional Auto-Cloned Photonics Crystal on Sapphire Substrate, ***Chen Yang Huang**[1,2], Hao Min Ku[1], Shiuh Chao[1]; [1]Natl. Tsing Hua Univ., Taiwan, [2]Industrial Technology Res. Inst., Taiwan.* Laser interference lithography method was used to form patterned sapphire substrate (PSS). Three-dimensional photonics crystal was formed by auto-cloning the PSS with alternate Ta_2O_5/SiO_2 coatings. Light emission of the sapphire-based LED can therefore be manipulated.

WB4 • 10:45 a.m.
Band Structure Analysis of One-Dimensional Photonic Crystals with Dispersive Left Handed Materials by Using Equivalent Layer Functions, *Jorge A. Gaspar[1],* ***Francisco V. Villa**[2], Alberto Mendoza-Suárez[3]; [1]Dept. de Investigación en Física, Univ. de Sonora, Mexico, [2]Ctr. de Investigaciones en Óptica, Mexico, [3]Univ. Michoacana de San Nicolás de Hidalgo, Mexico.* The band structure of one-dimensional photonic crystals composed of dielectrics and metamaterials is analyzed in terms of functions of materials parameters. The formalism of equivalent layers is extended to study bands formed from interface modes.

WB5 • 10:50 a.m.
Heat Induced Structural Rearrangement and Crystallite Formation in Thin Films of Room Temperature Plasma-Polymerized Titanium (IV) Isopropoxide, ***Hao Jiang**[1,2], Lirong Sun[1,2], John T. Grant[1,3], Kurt G. Eyink[1], Timothy J. Bunning[1], Rachel Jakubiak[1]; [1]AFRL, USA, [2]General Dynamics Information Technology, USA, [3]Univ. of Dayton Res. Inst., USA.* Analysis of plasma polymerized $TiO_xC_yN_z$ films annealed in the temperature range of 300-700 ^oC, revealed different mechanisms responsible for film densification below 300^oC and the formation of TiO_2 crystalline phases at temperatures over 500 ^oC.

WB6 • 10:55 a.m.
Densification of Plasma Polymerized $TiO_xN_yC_z$ Films with Air Exposure, ***Lirong Sun**[1,2], Hao Jiang[1,2], John T. Grant[1,3], Timothy J. Bunning[1], Rachel Jakubiak[1]; [1]AFRL, Materials and Manufacturing Directorate, USA, [2]General Dynamics Information Technology, USA, [3]Univ. of Dayton Res. Inst., USA.* $TiO_xN_yC_z$ thin films plasma polymerized at room temperature experienced significant decreases in film thickness and increases in refractive index with time during air exposure. Correlation of optical and structural changes provided insight into densification mechanisms.

WB7 • 11:00 a.m.
Measurement of the Deformation of Silicon Substrates Coated with a Plasma-Polymerized Acrylonitrile Film, ***David P. Sisler, Jr.**[1], Vincent P. Tondiglia[1,2], Hao Jiang[1,3], Jesse O. Enlow[1,4], Rachel Jakubiak[1]; [1]AFRL, USA, [2]SAIC, USA, [3]Materials Science and Technology Applications, USA, [4]UES Inc., USA.* A sensitive interferometric method is employed to quantify the deformation of silicon substrates coated with thin plasma-polymerized acrylonitrile film deposited at room temperature. This provides insight into the structural variation of plasma polymerized films.

WB8 • 11:05 a.m.
The Effect of Aerospace Environment on Band-Pass Filters Fabricated by Ion-Assisted Deposition Process, ***Hung-Pin Chen**, Chien Nan Hsiao, Po Kai Chiou, Wen Hao Cho; Instrument Technology Res. Ctr., Natl. Applied Res. Labs, Taiwan.* Band-pass filters fabricated by using IAD process were investigated for the aerospace application. The results indicated that transmittance decreases less than 2% after the radiation and thermal vacuum test.

PWAB • Poster Session V

Grand Ballroom Salon A
11:10 a.m.–12:00 p.m.

Posters included in this session are:

WA2	**WB2**
WA3	**WB3**
WA4	**WB4**
WA5	**WB5**
WA6	**WB6**
WA7	**WB7**
WA8	**WB8**
WA9	
WA10	
WA11	
WA12	

Kiva Ballroom
12:00 p.m.–1:30 p.m.
Lunch

WC • Polarization

Grand Ballroom Salon B&C
1:30 p.m.–2:35 p.m.
Brian Sullivan; Iridian Spectral Technologies, Canada, Presider
Xu Liu; Zhejiang Univ., China, Presider

WC1 • 1:30 p.m. **Invited**
Polarizing and Non-Polarizing Thin Film Coatings, *Li Li*; *Natl. Res. Council Canada, Canada.* Polarizing and non-polarizing thin film coatings are reviewed that are based on thin film interference effect or in combination with other effects including frustrated total internal reflection, birefringent films and form birefringence of sub-wavelength structures.

WC2 • 1:55 p.m.
Optical Thin Film Linear-Polarization Selector Fabricated by Oblique Angle Deposition, *Yong Jun Park, K. M. Abdus Sobahan, Ji Bum Kim, Jin Joo Kim, Yu Zou,* ***Chang Kwon Hwangbo****; Inha Univ., Republic of Korea.* In this study, a linear-polarization selector, made of a three-section sculptured thin film, is reported. Within the Bragg regime, the normal incident P-polarized light is transmitted through it, while the incident S-polarized light is reflected.

WC3 • 2:00 p.m.
Achromatic Polarization Switch by Using a Single Anisotropic Columnar Thin Film, *Yi-Jun Jen,* ***Meng-Jie Lin****, Wen-Pao Tsai; Dept. of Electro-Optical Engineering, Natl. Taipei Univ. of Technology, Taiwan.* This work presents a high efficient way to change polarization state from an anisotropic thin film. By using optimum thicknesses, the averaged polarization conversion reflectance over 80% can be obtained in the visible regime.

WC4 • 2:05 p.m.
Polarization Beam Splitters with Autocloned Symmetric Structure, *Sheng-Hui Chen*[1]*, Chun-Hung Wang*[1]*, Kwang-Yao Chai*[1]*, Te-Hung Chang*[1]*, Yu-Wen Yeh*[1]*, Cheng-Chung Lee*[1]*, Shih-Liang Ku*[2]*, Chao-Chun Huang*[2]*;* [1]*Natl. Central Univ., Taiwan,* [2]*Chung-Shan Inst. of Science and Technology, Taiwan.* We fabricated TiO_2 /SiO_2 2-D polarization beam splitters using electron beam gun evaporation with ion-beam-assisted deposition. Symmetric structure designs have been applied to reduce ripples and achieve 200 nm of working range.

WC5 • 2:10 p.m.
Ion Assisted Deposition of Conformal Coatings for the Manufacture of Large Area Wire Grid Polarizers, *Bruce MacLeod*, *Douglas J. Smith, Bing Xu, Sean D. Smith, Mike McCullough; Plymouth Grating Lab, USA.* Ion-assisted evaporation is used to dielectric coat gratings in a process scalable to manufacturing on meter-scale substrates. Conformal coating is the critical step in Self-Aligned Double Patterning used to extend the resolution of optical lithography.

WC6 • 2:15 p.m.
Performance of Embedded Grating Polarizing Beam-Splitters Varying with Grating Period and Angles of Incidence, *Li Li*; *Natl. Res. Council Canada, Canada.* Visible grating polarizing beam-splitters imbedded in prism substrates are analyzed using rigorous coupled wave analysis method and effective medium theory. The performance of the device depends on the grating period and angles of incidence.

WC7 • 2:20 p.m.
Analysis of Coating-Induced Polarization Aberrations by Jones Matrix, *Yanghui Li, Weidong Shen, Zhenyue Luo,* ***Xu Liu****, Peifu Gu; State Key Lab of Modern Optical Instrumentation, Zhejiang Univ., China.* Coating-induced polarization aberrations and the method to reduce the aberrations are theoretically studied by Jones matrix. Numerical simulation of the aberrations is performed to further verify the theory.

WC8 • 2:25 p.m.
Multilayer Design for P- and S-Polarized Long-Range Surface-Plasmon-Polariton Waves, *Ching-Wei Yu*, *Yi-Jun Jen; Dept. of Electro-Optical Engineering, Natl. Taipei Univ. of Technology, Taiwan.* Multilayer design for long-range surface-plasmon-polariton (LRSPP) propagation is investigated in the prism-coupling configuration {prism/ coupling layer/silver film(20 nm)/ Ta_2O_5 layer/ air}. A normalized admittance diagram is used as a tool to complete the LRSPP design.

WC9 • 2:30 p.m.
An Automatic Method for Optimization of Optical Parameters and Electric Filed Distributions in Thin-Film Polarizers, *Naibo Chen*[1,2]*,* ***Yonggang Wu***[1]*, Zhenhua Wang*[1]*, Leijie Ling*[1]*, Zihuan Xia*[1]*, Heyun Wu*[1]*, Gang Lv*[1]*;* [1]*Tongji Univ., China,* [2]*Zhejiang Univ. of Technology, China.* An efficient method based on the needle optimization of a new merit function is proposed to design thin-film polarizers. Improved electric field characteristics are observed in comparison with those obtained by the traditional merit function.

Grand Ballroom Foyer
2:35 p.m.–3:05 p.m.
Coffee Break/Exhibits

WD • Coating Stress

Grand Ballroom Salon B&C
3:05 p.m.–4:25 p.m.
Xinbin Cheng; Tongji Univ., China, Presider
Bob Hallock; Semrock/IDEX Corp., USA, Presider

WD1 • 3:05 p.m. **Invited**
Optical Coatings under Load, ***Alan F. Stewart****; Boeing, USA.* Optical coatings respond in several ways when exposed to high optical power levels. Absorption in the coating, localized heating at defects, and the stress strain induced on the overall structure will be discussed.

WD2 • 3:30 p.m.
Mechanical Design of Thermally Invariant Mirrors Coated by Atomic Layer Deposition, ***Nicholas T. Gabriel****, Sangho S. Kim, Joseph J. Talghader; Univ. of Minnesota, USA.* Thermal expansion mismatch between the layers of an optical coating and its substrate alters the shape of an optical element. We demonstrate predictable coating behavior using atomic layer deposition and apply to high-reflectivity mirror design.

WD3 • 3:35 p.m.
Control of Stress in Protected Silver Mirrors Prepared by Plasma Beam Sputtering, ***James D. Barrie****, Peter D. Fuqua, Kelsey Folgner, Chung-Tse Chu; The Aerospace Corp., USA.* Dielectric protected silver mirrors were prepared by plasma beam sputtering. Stress in the coatings was modified by adjusting deposition parameters. Reductions in stress were achieved without impacting coating durability.

WD4 • 3:40 p.m.
CEA Deformable-Mirror Coating Test Results, ***Amy L. Rigatti***[1], *James B. Oliver*[1]*, Pete Kupinski*[1]*, Herve Floch*[2]*, Eric Lavastre*[2]*, Guillaume Ravel*[3]*, Francoise Geffraye*[3]*;* [1]*Univ. of Rochester, USA,* [2]*CEA-CESTA, France,* [3]*CEA-GRENOBLE, France.* The deformable mirror used in CEA's Laser Mega-Joule System is a challenge to coat and control film stress to meet wavefront requirements. Stress data under various process conditions with an electron-beam deposition system is presented.

WD5 • 3:45 p.m.
Stress Compensation in Hafnia/Silica Optical Coatings by Inclusion of Alumina Layers, ***James B. Oliver****, Pete Kupinski, Amy L. Rigatti, Ansgar W. Schmid, John C. Lambropoulos, Semyon Papernov, Alexei Kozlov, Robert D. Hand; Univ. of Rochester, USA.* Tensile stresses in hafnia/silica coatings used in vacuum are mitigated by alumina in the multilayer design. Inclusion of interfacial effects and the influence of different layer thicknesses allows the production of low-compressive-stress, high laser-damage-threshold coatings.

WD6 • 3:50 p.m.
Modification of Stresses in Evaporated Hafnia Coatings for Use in Vacuum, ***James B. Oliver****, Pete Kupinski, Amy L. Rigatti, Ansgar W. Schmid, John C. Lambropoulos, Semyon Papernov, Alexei Kozlov, Robert D. Hand; Univ. of Rochester, USA.* Tensile stresses in hafnia/silica coatings used in vacuum are modified by changes in process variables and design. Stress aging is extended through the use of thin-layer designs, but long-term improvements in stress are not realized.

WD7 • 3:55 p.m.
Interface Stress of Oxide Thin Films Produced by DC Pulse Magnetron Sputtering Deposition, ***Kun-Hsien Lee***[1]*, Chia-Chen Lee*[1]*, Chien-Jen Tang*[2]*, Cheng-Chung Jaing*[2]*, Hsi-Chao Chen*[3]*, Cheng-Chung Lee*[1]*;* [1]*Natl. Central Univ., Taiwan,* [2]*Minghsin Univ. of Science and Technology, Taiwan,* [3]*Natl. Yunlin Univ. of Science and Technology, Taiwan.* Residual and interface stress of SiO_2 and Nb_2O_5 films on glass, PC, and PET have been investigated. When Nb_2O_5 was coated on SiO_2, the interface stress was tensile. While coated films reversely, it was compressive.

WD8 • 4:00 p.m.
Effect of Thermal Annealing on the Residual Stress of Graded-Index-Like Films Deposited by RF Ion-Beam Sputtering, ***Chien-Jen Tang***[1]*, Cheng-Chung Jaing*[1]*, Kun-Hsien Lee*[2]*, Cheng-Chung Lee*[2]*;* [1]*Dept. of Optoelectronic System Engineering, Minghsin Univ. of Science and Technology, Taiwan,* [2]*Dept. of Optics and Photonics, Thin Film Technology Ctr., Natl. Central Univ., Taiwan.* Composite film of Ta-Si oxide with graded-index-like films has been realized by using RF ion-beam sputtering. The influence of thermal annealing on residual stress of single layer composite films and graded-index-like films has been studied.

WD9 • 4:05 p.m.
Analysis of Long-Term Internal Stress and Film Structure of SiO_2 Optical Thin Films, ***Toshiyuki Nishikawa***[1]*, Hiroi Ono*[1]*, Hiroshi Murotani*[1]*, Yoshitaka Iida*[2]*, Katsuhisa Okada*[2]*;* [1]*Course of Electro Photo Optics, Graduate School of Tokai Univ., Japan,* [2]*Shincron Co., Ltd., Japan.* The stress of the film is an important parameter which relates to the adhesion of the film. In this report, time dependence of the stress of SiO_2 optical thin films is discussed.

WD10 • 4:10 p.m.
Tuning Residual Stress of Ion-Beam Assisted Thin Films during Annealing with Film Thickness and Substrate Temperature, ***Hsi-Chao Chen****, Chen-Yu Huang; Natl. Yunlin Univ. of Science and Technology, Taiwan.* The residual stress could tune from compression to tension by adding the film thickness and from tension to compression by adding the substrate temperature. During annealing the residual stress, optical properties and XRD were investigated.

WD11 • 4:15 p.m.
Residual Stress Analysis for Oxide Thin Films with Different Substrate and Temperature by Finite Element Method, *Hsi-Chao Chen,* ***Chen-Yu Huang****; Natl. Yunlin Univ. of Science and Technology, Taiwan.* These residual stresses were compressive and decreased with the increasing of substrate temperature for BK-7 and Pyrex substrates. The residual stresses were tensile and decreased with the increasing of substrate temperature for Vycor substrates.

WD12 • 4:20 p.m.
Study on the Measurement and Mechanism of Stress in SiO_2 Thin Films, ***Tao Ding****, Xiaowen Ye, Yongli Liu, Hongfei Jiao, Jinlong Zhang, Xinbin Cheng, Zhanshan Wang; Tongji Univ., China.* Residual stresses in the SiO_2 films prepared by electron beam evaporation were measured in air and nitrogen, respectively. The correlations between the stresses and coating parameters were studied in order to realize the stress control.

PWCD • Poster Session VI

Grand Ballroom Salon A
4:25 p.m.–5:20 p.m.

Posters included in this session are:

WC2	**WD2**
WC3	**WD3**
WC4	**WD4**
WC5	**WD5**
WC6	**WD6**
WC7	**WD7**
WC8	**WD8**
WC9	**WD9**
	WD10
	WD11
	WD12

Poolside
6:00 p.m.–7:30 p.m.
Conference Reception

NOTES

• Thursday, June 10 •

Grand Ballroom Foyer
8:00 a.m.–5:00 p.m.
Registration Open

ThA • Materials

Grand Ballroom Salon B&C
8:20 a.m.–9:35 a.m.
Ludvik Martinu; École Polytechnique de Montréal, Canada, Presider
Carl Ribbing; Uppsala Univ., Sweden, Presider

ThA1 • 8:20 a.m. **Invited**
Coating Materials for High Quality Films, *Bram Vingerling*; *Merck KGaA, Germany.* High quality evaporation materials can not simply be characterized by purity indications like >99.99%. Other aspects like application related impurity control and suitability for the evaporation process are more important for reliable optical coating production.

ThA2 • 8:45 a.m.
Fluoride Materials for High-Quality IR Coatings, *Markus Stolze*; *UMICORE Materials AG, Thin Film Products, Liechtenstein.* Pure and mixed fluoride materials are interesting alternatives to existing fluorides for IR applications with high requirements. Results are presented for evaporated films of a number of pure fluorides and new or optimized fluoride mixtures.

ThA3 • 8:50 a.m.
Optical Properties of Evaporated Organic Thin Films, *Ulrike Schulz*, *Christiane Präfke, Manuela Holz, Norbert Kaiser; Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* Organic compounds have great potential for use in electronics applications. Moreover, organic layers can be used to realize special functions in optical interference coatings. Three compounds were thermally evaporated and characterized.

ThA4 • 8:55 a.m.
Optical Properties of Ion Beam Sputtered Oxide Mixture Coatings, *Mathias Mende*, *Stefan Günster, Henrik Ehlers, Detlev Ristau; Laser Zentrum Hannover e.V., Germany.* Mixture thin films with different ratios are produced by ion beam sputtering. The refractive index is correlated with the composition determined by energy dispersive X-ray spectroscopy. Results for HfO_2/Al_2O_3, Ta_2O_5/SiO_2 and Al_2O_3/SiO_2 mixtures are presented.

ThA5 • 9:00 a.m.
Development of Empirical Models for the Prediction of Refractive Index of Optical Thin Film Materials in Ion Beam Assisted Evaporation Processes, *Dirk Isfort*, *Stephane Bruynooghe, Diana Tonova, Stefan Spinzig; Carl Zeiss Jena GmbH, Germany.* Empirical Models for the prediction of spatial distribution of refractive index and film thickness of thin films on optical substrates have been developed as a function of processing parameters during ion assisted evaporation for Ta_2O_5.

ThA6 • 9:05 a.m.
Optical Parameters of Oxide Films Typically Used in Optical Coating Production, *Alexander V. Tikhonravov[1], Michael K. Trubetskov[1], **Tatiana V. Amotchkina**[1], Gary DeBell[2], Vladimir Pervak[3], Anna Krasilnikova Sytchkova[4]; [1]Res. Computing Ctr., Moscow State Univ., Russian Federation, [2]MLD Technologies, USA, [3]Ludwig-Maximilians-Univ. München, Germany, [4]Natl. Agency for New Technologies, Energy, and the Environment, Italy.* A method for creating a database of dispersive refractive indices of thin film materials is outlined. Refractive indices for the most widely used metal oxide films produced under different deposition conditions are presented.

ThA7 • 9:10 a.m.
Effect of Annealing on the Optical Properties of HfO_2, *Peter Langston*[1], *Dinesh Patel[1], Ashot Markosyan[2], Erik M. Krous[1], D. Nguyen[2], Luke A. Emmert[2], W. Rudolph[2], R. Route[3], M. Fejer[3], Carmen S. Menoni[1]; [1]Colorado State Univ., USA, [2]Univ. of New Mexico, USA, [3]Stanford Univ., USA.* Post-annealing of HfO_2 is found to affect the absorption loss at 1 micron, and the subpicosecond laser-induced breakdown behavior. These effects are attributed to modifications of the density of intrinsic defects and photo-induced defects, respectively.

ThA8 • 9:15 a.m.
The Effects of Substrate Temperatures on the Structure and Properties of Hafnium Dioxide (HfO2) Films, *Hongfei Jiao[1,2], Xinbin Cheng[1], Yongli Liu[1], Jiangtao Lu[1], **Bin Ma**[1,2], Pengfei He[2], Zhanshan Wang[1]; [1]Inst. of Precision Optical Engineering, Physics Dept., Tongji Univ., China, [2]School of Aerospace Engineering and Applied Mechanics, Tongji Univ., China.* X-ray diffraction (XRD) was applied to determine the crystalline phase of HfO_2 films, deposited by electron beam evaporation (EB) under different conditions, the results revealed that their microstructures strongly depended on the temperatures of substrates.

ThA9 • 9:20 a.m.
Optical and Structural Properties of Amorphous Silicon Coatings Deposited by Magnetron Sputtering, *Stephane Bruynooghe*, *Nico Schmidt, M. Sundermann, H. W. Becker, Stephan Spinzig; Carl Zeiss Jena GmbH, Germany.* We report on the preparation and characterization of Si-coatings deposited by magnetron sputtering. The high packing density, amorphous structure and low optical absorption of the coatings demonstrates the high potential of this technology for IR-applications.

ThA10 • 9:25 a.m.
Thermal Expansion Coefficients of Obliquely Deposited MgF_2 Thin Films, *Cheng-Chung Jaing*[1], *Ming-Chung Liu[2], Cheng-Chung Lee[2], Bo-Huei Liao[2], Chien-Jen Tang[1]; [1]Minghsin Univ. of Science and Technology, Taiwan, [2]Natl. Central Univ., Taiwan.* Effects of columnar angles on the thermal expansion coefficients of MgF_2 films were investigated. The MgF_2 films with columnar microstructures were obliquely deposited on two types of glass substrates by means of resistive heating evaporation.

ThA11 • 9:30 a.m.
Eu Luminescence from a Metallo-Dielectric System, ***Aldo S. Ramirez Duverger***, *Raul García-Llamas, Raul Aceves, Jorge Gaspar-Armenta; Univ. de Sonora, Mexico.* The emission band from a Eu^{2+} ions in a four films system is measured. The films are MgF_2/Al /MgF_2/Al and are deposited on a Al substrate.

Grand Ballroom Foyer
9:35 a.m.–10:05 a.m.
Coffee Break

ThB • Optics at the University of Rochester

Grand Ballroom Salon B&C
10:05 a.m.–10:20 a.m.
H. Angus Macleod; Thin Film Ctr., USA, Presider
Karen D. Hendrix; JDS Uniphase, USA, Presider

ThB1 • 10:05 a.m. **Invited**
Optical Interference Coating Curriculum at the University of Rochester's Institute of Optics, ***Jennifer Kruschwitz***[1], *James B. Oliver*[2]; [1]*JK Consulting, USA,* [2]*Univ. of Rochester, USA.* This paper will highlight the history of coatings professors at the University of Rochester, how the initial curriculum has stood the test of time, and the use of new curriculum in advanced design techniques.

ThC • Measurement Contest and Measurement I

Grand Ballroom Salon B&C
10:20 a.m.–11:05 a.m.
H. Angus Macleod; Thin Film Ctr., USA, Presider
Karen D. Hendrix; JDS Uniphase, USA, Presider

ThC1 • 10:20 a.m. **Invited**
2010 OSA Topical Meeting on Optical Interference Coatings: Measurement Problem, ***Angela Duparré***[1], *Detlev Ristau*[2]; [1]*Fraunhofer Inst. Angewandte Optik und Feinmechanik, Germany,* [2]*Laser Zentrum Hannover e.V., Germany.* The Measurement Problem comprises the determination of the reflectance R of high-reflective dielectric laser mirrors at 1064 nm, AOI 0°.

ThC2 • 10:50 a.m.
LID Technique for Absolute Thin Film Absorption Measurement: Optimized Concepts, Experimental Results and Advanced Prototype, ***Christian Mühlig***[1], *Simon Bublitz*[1], *Siegfried Kufert*[1], *Uwe Speck*[2]; [1]*Inst. of Photonic Technology, Germany,* [2]*SPECK Sensorsysteme GmbH, Germany.* Concepts for LID technique are applied for absolute thin film absorption measurements from DUV to IR wavelengths. Various experimental results, the achieved repeatability and an advanced prototype with high sensitivity and improved handling are presented.

ThC3 • 10:55 a.m.
The Influence of Optical Feedback Strength on Cavity Ring-Down Technique for High Reflectivity Measurements, *Zhechao Qu,* ***Bincheng Li***, *Yanling Han; Inst. of Optics and Electronics, Chinese Acad. of Sciences, China.* The influence of optical feedback strength on the cavity ring-down (CRD) technique for high reflectivity measurements is investigated. The different feedback strengths affect the laser spectrum and the temporal behaviors of the CRD signals differently.

ThC4 • 11:00 a.m.
Theoretical Analysis of Laser Calorimetry with Temperature Rise on Front and Rear Surfaces of Optical Components, *Yanru Wang,* ***Bincheng Li***; *Inst. of Optics and Electronics, Chinese Acad. of Sciences, China.* A rigorous temperature model is applied to analyze the optimum detection location in laser calorimetry for absorptance measurement, with temperature rise on front and rear surfaces of optical components.

PThAC • Poster Session VII

Grand Ballroom Salon A
11:05 a.m.–12:00 p.m.

Posters included in this session are:

ThA2	**ThC2**
ThA3	**ThC3**
ThA4	**ThC4**
ThA5	
ThA6	
ThA7	
ThA8	
ThA9	
ThA10	
ThA11	

Kiva Ballroom
12:00 p.m.–1:30 p.m.
Lunch

ThD • Measurement II

Grand Ballroom Salon B&C
1:30 p.m.–2:40 p.m.
Mireille Commandré; Inst. Fresnel, France, Presider
Michael Jacobson; Optical Data Associates, USA, Presider

ThD1 • 1:30 p.m. **Invited**
Angle Resolved Scattering from Optical Filters for Space Applications, ***Peter Fuqua***[1], *Tom Mooney*[2], *J. D. Barrie*[1], *David Rock*[1], *H. I. Kim*[1]; [1]*The Aerospace Corp., USA,* [2]*Barr Associates, Inc., USA.* Multilayer dielectric bandpass coatings were deposited on a variety of substrates to assess the effect of surface condition on out-of-band angle resolved scattering (ARS).

ThD2 • 1:55 p.m.
ARS: An Effective Method for Characterizing Structural and Alteration Effects in Thin Film Coatings, ***Sven Schröder***[1], *Tobias Herffurth*[1], *Holger Blaschke*[2], *Angela Duparré*[1]; [1]*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany,* [2]*Laser Zentrum Hannover e.V., Germany.* Light scattering measurement and analysis based on a simplified scatter model for multilayer coatings is used to investigate structural and alteration effects of HR coatings for 193 nm and of Rugate filters for 355 nm.

ThD3 • 2:00 p.m.
Scattering of Roughened TCO Films - Modeling and Measurement, ***Sven Schröder***[1], *Angela Duparré*[1], *Kevin Füchsel*[1,2], *Norbert Kaiser*[1], *Andreas Tünnermann*[1,2], *James E. Harvey*[3]; [1]*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany,* [2]*Friedrich-Schiller-Univ. Jena, Germany,* [3]*Univ. of Central Florida, USA.* The scattering properties of roughened TCO films are modeled and compared to experiment using a new approach which is valid not only for smooth surfaces but also for rough light trapping structures for solar cells.

ThD4 • 2:05 p.m.
Instrument for Close-to-Process Light Scatter Measurements of Thin Film Coatings and Substrates, ***Alexander von Finck***, *Matthias Hauptvogel, Angela Duparré; Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* Scatter analysis is an effective method for characterization of thin film components. For flexible and easy use in research and industry the high-sensitive table-top system ALBATROSS-TT with full 3-D-spherical measurement capability has been developed.

ThD5 • 2:10 p.m.
Measuring Optical Scatter at Material Interfaces Using a Hemisphere, ***Robert F. Cartland, Jr.***; *Spectrophotometry and Scatter Lab, Raytheon Space and Airborne Systems, USA.* Interfacial light scatter within a substrate was measured using a hemisphere. The hemisphere corrects the problem of refractive beam displacement allowing the bidirectional reflectance distribution function within the substrate to be determined.

ThD6 • 2:15 p.m.
Optical Component Interfaces Characterization by Selective Polarization Extinction, ***Gaëlle Georges***, *Carolé Deumie, Claude Amra; Inst. Fresnel, CNRS, Aix-Marseille Univ., École Centrale Marseille, France.* Procedure for selective extinction of light scattering is described. It is based on null ellipsometry principles applied on scattered fields. In this paper, this technique is used for isolate each interface of a multilayer component.

ThD7 • 2:20 p.m.
A Goniometric Instrument for a Spatially Resolved Scattering and Polarimetric Characterisation of Optical Coatings, ***Myriam Zerrad***, *Michel Lequime, Carole Deumie, Claude Amra; Inst. Fresnel, France.* A CCD-ARS set-up is presented. This new high sensitivity instrument allows both spatial and angular resolved measurement of scattered fields intensity and polarimetic characteristics. Applications to the comprehensive characterization of optical coatings are given.

ThD8 • 2:25 p.m.
Roughness Structures of Ultrahydrophobic and Hydrophilic Coatings on Glass, ***Luisa Coriand***[1,2], *Monika Mitterhuber*[3], *Angela Duparré*[1]; [1]*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany,* [2]*Friedrich-Schiller-Univ., Germany,* [3]*ETC PRODUCTS GmbH, Germany.* With specific modelling, measurement, and analysis procedures it is possible to predict, define and control roughness structures for optimal hydrophobic and hydrophilic coatings on glass. Examples are given for sol-gel-layers with ultrahydrophobic and hydrophilic properties.

ThD9 • 2:30 p.m.
Two Steps in the Characterization of HR Coatings: Measuring the Thermo-Refractive Coefficient and Characterizing Scatter, ***Andri M. Gretarsson***[1], *Joshua R. Smith*[2]; [1]*Embry-Riddle Aeronautical Univ., USA,* [2]*Syracuse Univ., USA.* We present methods for characterizing the thermo-refractive coefficient β and the properties of scatter in HR coatings for use in low-noise optical cavities such as those required for Advanced LIGO.

ThD10 • 2:35 p.m.
The Evaluation and Analysis of Polished Fused Silica Subsurface Quality by Nanoindenter Technique, ***Bin Ma***[1,2], *Zhengxiang Shen*[1], *Pengfei He*[2], *Fei Sha*[3], *Chunliang Wang*[3], *Bin Wang*[3], *Yiqin Ji*[4], *Huasong Liu*[4], *Weihao Li*[4], *Zhanshan Wang*[1]; [1]*Inst. of Precision Optical Engineering, Tongji Univ., China,* [2]*School of Aerospace Engineering and Applied Mechanics, Tongji Univ., China,* [3]*Shanghai Res. Inst. of Materials, China,* [4]*Tianjin Key Lab of Optical Thin Films, Tianjin Jinhang Inst. of Technical Physics, China.* The nanoinderter technique is introduced to evaluate the subsurface quality of polished SiO_2 samples. Some noticeable differences are found between the two kinds of results in terms of mechanical parameters and constant indented topography.

Grand Ballroom Foyer
2:40 p.m.–3:10 p.m.
Coffee Break

ThE • Measurement III

Grand Ballroom Salon B&C
3:10 p.m.–4:10 p.m.
Angela Duparré; Fraunhofer Inst. Angewandte Optik und Feinmechanik, Germany, Presider
Noriaki Toyoda; Univ. of Hyogo, Japan, Presider

ThE1 • 3:10 p.m. **Invited**
Spectrophotometric Measurements, ***Maria Nadal***; *NIST, USA.* Spectrophotometric measurements are the quantitative determination of reflection or transmission properties of materials as a function of wavelength. These measurements are a powerful technique for characterizing the scattering mechanisms present in materials.

ThE2 • 3:35 p.m.
A Possibility for Checking Microcomponent Coatings, ***Hervé Piombini***[1], *Philippe Voarino*[1], *Fabien Lemarchand*[2]; [1]*CEA, France,* [2]*Univ. Paul Cézanne, France.* Optical micro-components are increasingly used in optical systems. The optical characterizations are very hard due to their shape and small size. So to perform this kind of measurement, special devices are needed.

ThE3 • 3:40 p.m.
Estimation of Phase Shifts Only Linked to Coating for a Dielectric Mirror, ***Hervé Piombini***; *CEA, DAM, France.* The wavefront is an important characteristic for a dielectric mirror. Its measurement is usually performed with interferometers. We introduce a new method for evaluating only the coating wavefront by using a reflectometer.

ThE4 • 3:45 p.m.
Optical Constant and Thickness Measurements through Multi-Wavelength Interferometry, ***Kai Wu****, Yi -Hong Liu, Cheng-Chung Lee; Dept. of Optics and Photnics, Thin Film Technology Ctr., Natl. Central Univ., Taiwan.* By measuring phase and reflectance at different wavelengths in an interferometer, optical constants and thickness of coating, and path length difference between two arms were obtained. No blnak reference region on the substrate was needed.

ThE5 • 3:50 p.m.
Antireflective Layers on Thin Metal Films for Mid-Infrared Internal Reflection Spectroscopy, ***Martina Reithmeier****, Andreas Erbe; Max-Planck-Inst. für Eisenforschung GmbH, Germany.* Mid-infrared transparent, micrometer-thick coatings on infrared-transparent substrates for use with attenuated total internal reflection infrared (ATR-IR) spectroscopy through metal films are introduced. The coatings enhance the tunneling of light through the metals.

ThE6 • 3:55 p.m.
Paper Withdrawn

ThE7 • 4:00 p.m.
Spectral Polarimetry Technique as a Complementary Tool to Ellipsometry of Dielectric Films, ***Marcelo B. Pereira****, Bruno J. Barreto, Flavio Horowitz; Univ. Federal do Rio Grande do Sul, Brazil.* A method using Spectral Polarimetry is proposed to prevent multiple solutions in Ellipsometry by providing film dispersion curves independently of physical thicknesses. Validity of the method is tested with a single-solution, very thin TiO_2 coating.

ThE8 • 4:05 p.m.
Speckle Histograms for a Direct Determination of Cross-Correlation Laws in the Light Scattering Process of Multilayer Optics, ***Myriam Zerrad****, Jacques Sorrentini, Claude Amra; Inst. Fresnel, France.* A statistical and electromagnetic study of speckle intensity patterns scattered by multilayers components is related to the coatings microstructure. Cross-correlation coefficients between interface roughnesses and scattering losses origin are deduced from speckle histogram behaviour.

PThDE • Poster Session VIII

Grand Ballroom Salon A
4:10 p.m.–4:45 p.m.

Posters included in this session are:

ThD2	**ThE2**
ThD3	**ThE3**
ThD4	**ThE4**
ThD5	**ThE5**
ThD6	**ThE7**
ThD7	**ThE8**
ThD8	
ThD9	
ThD10	

• Friday, June 11 •

Grand Ballroom Foyer
8:00 a.m.–12:00 p.m.
Registration Open

FA • High Power and Laser Damage

Grand Ballroom Salon B&C
8:20 a.m.–9:40 a.m.
Angela M. Piegari; Optical Coatings Group, ENEA, Italy, Presider
Ric Shimshock; MLD Technologies, LLC, USA, Presider

FA1 • 8:20 a.m. **Invited**
Coatings for High Power Lasers, ***Hongbo He****; Shanghai Inst. of Optics and Fine Mechanics, Chinese Acad. of Sciences, China.* Recent progresses of our group in coatings for high power lasers will be reviewed, including development of characterization tools, laser damage mechanisms, post-treatments, stress monitoring solution and approaches of novel optical coatings.

FA2 • 8:45 a.m.
Multilayer Coating Laser Damage Stabilization by Femtosecond Laser Machining, ***Justin E. Wolfe****, S. Roger Qiu, Christopher J. Stolz; LLNL, USA.* Femtosecond laser machining is optimized to stabilize nanosecond induced-laser damage and to double the power handling capability of multilayer mirror coatings. Higher per-pulse energy of the machining laser degrades the feature edge quality.

FA3 • 8:50 a.m.
Searching for Optimal Mitigation Geometry for Multilayer High Reflector Coatings, ***S. Roger Qiu***[1]*, Justin E. Wolfe*[1]*, Anthony M. Monterrosa*[2]*, Michael D. Feit*[1]*, Thomas V. Pistor*[3]*, Christopher J. Stolz*[1]*;* [1]*Lawrence Livermore Natl. Lab, USA,* [2]*Dept. of Nuclear Engineering and Dept. of Materials Science and Engineering, Univ. of California at Berkeley, USA,* [3]*Panoramic Technology, Inc., USA.* Computer simulations using finite difference time domain of conical pits show that electric field intensification within multilayer high reflector coatings is minimized when the incident and cone angle are matched.

FA4 • 8:55 a.m.
Fundamental Processes Controlling the Multiple Subpicosecond Laser Pulse Damage Behavior of Dielectric Optical Coatings, ***Luke A. Emmert***[1]*, Duy N. Nguyen*[1]*, Mark Mero*[1]*, Wolfgang Rudolph*[1]*, Erik Krous*[2]*, Dinesh Patel*[2]*, Carmen S. Menoni*[2]*;* [1]*Univ. of New Mexico, USA,* [2]*Colorado State Univ., USA.* The role of native and laser-induced defect states in the multiple-pulse damage behavior of wide gap optical materials is presented. A few examples of experiment and modeling are given to highlight our current understanding.

FA5 • 9:00 a.m.
Multiple Subpicosecond Pulse Laser Damage Behavior of Optical Coatings in a Vacuum Environment, *Duy N. Nguyen*[1]*,* ***Luke A. Emmert***[1]*, Wolfgang A. Rudolph*[1]*, Erik Krous*[2]*, Dinesh Patel*[2]*, Carmen S. Menoni*[2]*, Michelle Shinn*[3]*;* [1]*Univ. of New Mexico, USA,* [2]*Colorado State Univ., USA,* [3]*Thomas Jefferson Natl. Accelerator Facility, USA.* The multiple-pulse damage threshold of dual-ion beam sputtered films show a drop to just 10% of the single-pulse damage threshold when tested in vacuum. The drop is related to the background pressure of water vapor.

FA6 • 9:05 a.m.
Optical Resistance of Ion Beam Sputtered Zirconia/Silica and Niobia/Silica Mixture Coatings in Femtosecond Regime, *Andrius Melninkaitis*[1]*, Julius Mirauskas*[1]*, Maksim Jeskevic*[1]*, Valdas Sirutkaitis*[1]*, Benoit Mangote*[2]*, Xavier Fu*[2]*, Myriam Zerrad*[2]*,* ***Laurent Gallais***[2]*, Mireille Commandré*[2]*, Tomas Tolenis*[3]*, Simonas Kicas*[3]*, Ramutis Drazdys*[3]*;* [1]*Vilnius Univ., Lithuania,* [2]*Inst. Fresnel, France,* [3]*Inst. of Physics, Lithuania.* In this study, we present our recent progress in research of mixed zirconia/silica and niobia/silica coatings prepared by Ion Beam Sputtering technique. Single-layer coatings of the same optical thickness were characterized with respect to LIDT.

FA7 • 9:10 a.m.
Laser Induced Damage of Hafnia Coatings as a Function of Pulse Duration in the Femto to Picosecond Regime, ***Laurent Gallais***[1]*, Benoit Mangote*[1]*, Myriam Zerrad*[1]*, Mireille Commandré*[1]*, Andrius Melninkaitis*[2]*, Julius Mirauskas*[2]*, Maksim Jeskevic*[2]*, Valdas Sirutkaitis*[2]*;* [1]*Inst. Fresnel, CNRS, Aix-Marseille Univ., École Centrale Marseille, France,* [2]*Laser Res. Ctr., Vilnius Univ., Lithuania.* LIDT with pulse duration ranging from fs to ns is measured in hafnia single layers made with different deposition techniques. Simulations are compared to experiments in order to describe laser damage in hafnia.

FA8 • 9:15 a.m.
Comparisons of Hafnia/Silica Anti-Reflection Coatings, ***John Bellum****, Damon Kletecka, Patrick Rambo, Ian Smith, Jens Schwarz, Briggs Atherton; Sandia Natl. Labs, USA.* We report reflectivity, design and laser damage comparisons of our AR coatings for use at 1054 nm and/or 527 nm, and at angles of incidence between 0 and 45 degrees.

FA9 • 9:20 a.m.
HfO_2/SiO_2 High Reflectors for 1.064 μm High Power Laser Applications, ***Xinbin Cheng****, Zhengxiang Shen, Hongfei Jiao, Jinlong Zhang, Bin Ma, Tao Ding, Zhanshan Wang; Tongji Univ., China.* An optimized reactive E-beam evaporation process was used to deposit HfO_2/SiO_2 high reflectors for 1.064 μm high power applications. Laser induced damage threshold of the coatings was measured and possible damage mechanisms were discussed.

FA10 • 9:25 a.m.
Scandium Oxide Thin Films Deposited by Dual Ion Beam Sputtering for High-Power Laser Applications, ***Erik Krous***[1], *Dinesh Patel*[1], *Peter Langston*[1], *Carmen Menoni*[1], *Ashot Markosyan*[2], *Roger Route*[2], *Martin Fejer*[2], *Duy Nguyen*[3], *Luke Emmert*[3], *Wolfgang Rudolph*[3]; [1]*Colorado State Univ., USA*, [2]*Stanford Univ., USA*, [3]*Univ. of New Mexico, USA.* Scandium oxide films were deposited using reactive dual ion beam puttering. At 1 micron, the refractive index of the films is 1.95 and the absorption loss is 18.5 ppm. X-ray photoelectron spectroscopy showed oxygen defects.

FA11 • 9:30 a.m.
Geometrical Characteristics and Laser-Induced Damage of Artificial Nodules in Multilayer Coating, *Yongguang Shan,* ***Dawei Li****, Xiaofeng Liu, Ying Wang, Chaoyang Wei, Hongbo He; Chinese Acad. of Sciences, China.* Artificial nodules, planted with gold nanoparticles, have been analyzed by AFM, SEM and FIB. The geometrical characteristic parameter is 6.5, and damage resistance of the nodule relates to the morphologies of the nodules.

FA12 • 9:35 a.m.
Influence of Cleaning Process on the Laser Induced Damage Threshold of Substrates, *Zhengxiang Shen*[1], *Xiaodong Wang*[1], *Xiaowen Ye*[1], ***Bin Ma***[1], *Huasong Liu*[1,2], *Yiqin Ji*[2], *Zhanshan Wang*[1]; [1]*Inst. of Precision Optical Engineering, Tongji Univ., China,* [2]*Tianjin Key Lab of Optical Thin Film,Tianjin Jinhang Inst. of Technical Physics, Tianjin, China.* Two kinds of substrates, fused silica and BK-7 glass, are treated with ultrasonic cleaning protocol to determine the influence of cleaning process on LIDT. The contaminant-removal efficiency, weak absorption and LIDT are measured and analyzed.

Grand Ballroom Foyer
9:40 a.m.–10:10 a.m.
Coffee Break

FB • Ultrafast

Grand Ballroom Salon B&C
10:10 a.m.–11:15 a.m.
Michael L. Fulton; Ion Beam Optics Inc., USA, Presider
Hongbo He; Shanghai Inst. of Optics and Fine Mechanics, China, Presider

FB1 • 10:10 a.m. **Invited**
Recent Development and New Ideas in the Field of Dispersive Multilayer Optics, ***Volodymyr Pervak****; Ludwig-Maximilians-Univ. München, Germany.* Dispersive-mirror-based laser permits a dramatic simplification of high-power systems and affords promise for their advancement to shorter pulse durations, higher peak powers, and higher average powers with user-friendly systems.

FB2 • 10:35 a.m.
Femtosecond Laser Processing of Optical Thin Films: Experimental Tools and Results, ***Benoit Mangote****, Fabien Lemarchand, Myriam Zerrad, Laurent Gallais, Mireille Commandré, Michel Lequime; Inst. Fresnel, CNRS, Aix-Marseille Univ., École Centrale Marseille, France.* We present a laser irradiation bench for ablation and photo-inscription and a refractive index measurement setup developed for processing of optical interference coatings by femtosecond laser. First results will be presented at the conference.

FB3 • 10:40 a.m.
Relation between Group Delay, Energy Storage and Absorbed/Scattered Power in Highly Reflective Dispersive Dielectric Mirror Coatings, ***Róbert Szipőcs****, Peter Antal; Res. Inst. for Solid State Physics and Optics, Hungary.* We show that the reflection group delay as well as the absorption/scattering loss of a dielectric multilayer mirror is proportional to the energy stored in such 1-D photonic bandgap (PBG) devices.

FB4 • 10:45 a.m.
Direct Measurement of Group-Delay Properties for Dispersive Mirrors, *Zheng-yue Luo, Shu-na Zhang, Wei-dong Shen,* ***Xu Liu****; Zhejiang Univ., China.* Two distinct ways for direct measurement of group delay from white light spectral interferogram were investigated, including the numerical wavelet transformation and the scanning spectrally resolved method. Both generated measurement results with imporved accuracy.

FB5 • 10:50 a.m.
Complementary Chirped-Mirror Pair for Broadband Dispersion-Free Cavities, ***Li-Jin Chen****, Guoqing Chang, Jonathan R. Birge, Franz X. Kärtner; MIT, USA.* Chirped mirror pairs with complementary dispersion are proposed for construction of dispersion-free cavities. As an example a mirror pair for a filter cavity with a mirror reflectivity of ~99.2% and 100nm bandwidth (480-580nm) is designed.

FB6 • 10:55 a.m.
Dispersion-Free Reflective Phase Retarder for Few-Cycle Femtosecond Pulses, ***Gabriel F. Tempea****; Femtolasers Produktions GmbH, Austria.* A thin film based, dispersion-free reflective phase retarder introducing a retardation of lambda/4 +/-6% over 400 nm at 800 nm was developed for polarization management of high-energy few-cycle pulses.

FB7 • 11:00 a.m.
Design and Preparation of Chirped Mirrors Used in Ti:sapphire Lasers, *Yanzhi Wang,* ***Yuanan Zhao****, Yunxia Jin, Hongbo He, Kui Yi; Chinese Acad. of Sciences, China.* The designed chirped-mirror (CM), around -60fs^2 group delay dispersion in the wavelength 700-900nm, has been prepared by ion beam sputtering. By balancing the intra-cavity dispersion with manufactured non-pairs CMs, 9.5fs pulse is obtained.

FB8 • 11:05 a.m.
HfO_2/SiO_2 Chirped Mirrors Manufactured by Electron Beam Evaporation, *Zhang Jinlong,* ***Cheng Xinbin****, Wang Zhanshan, Jiao Hongfei, Ding Tao; Tongji Univ., China.* A HfO_2/SiO_2 chirped mirror was manufactured by E-beam evaporation to increase the laser resistance. The experimental results showed that the mirror possess high reflectivity and tolerable GDD oscillation in the spectra range of 740-860 nm.

11:10 a.m.–11:15 a.m.
Closing Remarks
Markus Tilsch; *JDS Uniphase Co., USA.*

PFAB • Poster Session IX

Grand Ballroom Salon A
11:15 a.m.–12:00 p.m.

Posters included in this session are:

FA2	**FB2**
FA3	**FB3**
FA4	**FB4**
FA5	**FB5**
FA6	**FB6**
FA7	**FB7**
FA8	**FB8**
FA9	
FA10	
FA11	
FA12	

Kiva Ballroom
12:00 p.m.–1:30 p.m.
Lunch

NOTES

Key to Authors and Presiders
(**Bold** denotes Presider or Presenting Author)

Optical Interference Coatings Update Sheet

Presentation Time Updates:
The OIC program will begin on Monday at **8:10 a.m.** with the Opening Remarks.
The David Cushing Memorial Talk will be given on Monday from 8:20 a.m.–8:30 a.m.
FA2 will begin at 8:50 a.m.
FA3 will begin at 8:45 a.m.

Session Updates

Session **WD** will now run until 4:45 p.m.

Poster Session **PWCD** will run from 4:45 p.m.–5:40 p.m.

Withdrawals:

TuD10

Presenter Update:
FA10 will be presented by *Carmen Menoni, Colorado State Univ., USA*

OIC would also like to thank the following companies for their generous contributions:

eci evaporated coatings inc

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Optical Interference Coatings
Postdeadline Paper Abstracts

Tuesday, June 8, 2010

TuD • Deposition Control and Applications

Grand Ballroom Salon B&C
3:15 p.m.–4:35 p.m.
Robert Schaffer; Evaporated Coatings, Inc., USA, Presider
François R. Flory; Ecole Centrale Marseille, France, Presider

PDTuD10 • 4:20 p.m.
From Passive to Active: Future Optical Security Devices, ***Bill Baloukas****, Jean-Michel Lamarre, Ludvik Martinu; École Polytechnique de Montréal, Canada.* Nowadays, passive devices offer good but limited anti-counterfeiting protection. We demonstrate design and fabrication of new color shifting security devices based on implementing an active electrochromic material, thus offering new optical features and enhanced protection.

Wednesday, June 9, 2010

WD • Coating Stress

Grand Ballroom Salon B&C
3:05 p.m.–4:45 p.m.
Xinbin Cheng; Tongji Univ., China, Presider
Bob Hallock; Semrock/IDEX Corp., USA, Presider

PDWD13 • 4:25 p.m.
Omnidirectional Structural Color, ***Debasish Banerjee****, Minjuan Zhang; Toyota Res. Inst. of North America, USA.* Avoiding angular-shift of an interference-based structural color remains a challenge. The design-criteria for first-ever omnidirectional structural colors have been discussed by treating a quarter-wave stack of alternating dielectric material layers as a one-dimensional photonic crystal.

PDWD14 • 4:30 p.m.
Design and Fabrication of Multi-channel Si/SiO_2 Autocloned Photonic Crystal Edge Filters, ***Yasuo Ohtera****, Hirohito Yamada; Tohoku Univ., Japan.* Si/SiO_2 multilayers having zigzag layer interfaces are fabricated on a patterned substrate using Autocloning method. The multilayer was designed as multichannel edge filters. Shift of the cut-off wavelengths by 190nm in NIR was experimentally demonstrated.

PDWD15 • 4:35 p.m.
Ultra-precise Optical Components with Machinable Silicon Layer, *Mark Schürmann, Paul-Johannes Jobst,* ***Norbert Kaiser****, Andreas Kolbmüller, Sandra Müller, Andreas Gebhardt, Stefan Risse, Ramona Eberhardt; Fraunhofer IOF, Germany.* Several micron thick silicon films deposited by magnetron sputtering have a nearly amorphous structure. Optical elements coated with theses films can be machined, polished, and structured in order to achieve ultra-precise optical components.

PDWD16 • 4:40 p.m.
An Environmentally Stable Replacement for Silver, ***Rick K. Nubling****, W. Michael Robbins; Sonoma Photonics, Inc., USA.* To date, few remedies have been available to circumvent long-term degradation effects of silver-based coatings. We present the results of a highly-reflective, environmentally-stable, coating that could replace silver-based mirror coatings.

Thursday, June 10, 2010

ThE • Measurement III

Grand Ballroom Salon B&C
3:10 p.m.–4:10 p.m.
Angela Duparré; Fraunhofer Inst. Angewandte Optik und Feinmechanik, Germany, Presider
Noriaki Toyoda; Univ. of Hyogo, Japan, Presider

PDThE6 • 3:55 p.m.
Mixed-Flowing-Gas Testing of Gold Mirror Coatings, ***Chung-Tse Chu****, Christopher J. Panetta, Diana R. Alaan; The Aerospace Corp., USA.* Atmospheric corrosion of four different gold mirror coatings was investigated with a mixed-flowing-gas environment. We report correlation of changes in optical properties of mirror samples with the morphology of the corrosion features on mirror surface.

OIC Postdeadline Papers Key to Authors and Presiders
(Bold denotes Presenting Author or Presider)