• 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
MC3
MC4
MC5
MC6
MC7
MC8
MC9
MC10

MD2
MD3
MD4
MD5
MD6
MD7

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