

Technical Program

Optifab 2007

Conference • Courses • Exhibition

Conference and Courses:
14–17 May 2007

Exhibition:
15–17 May 2007

Rochester Riverside Convention Center
Rochester, New York USA



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About SPIE

SPIE is a not-for-profit international society dedicated to furthering technological innovations. Established in 1955, SPIE has a long history of producing international meetings that push the forefront of photonics technologies and their applications.

About APOMA

The American Precision Optics Manufacturers Association represents a broad base of precision optics manufacturers and supporting industries whose mutual interest is to expand and advance optics manufacturing technology. The 150-member organization promotes regional educational centers for the optics industry, provides student grant funding, participates in the formation of optical standards for the industry, and actively sponsors technical workshops aimed at improving technical dialogue and exchange within the membership.

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James M. Sydor,
Sydor Optics, Inc.



Richard A. Nasca,
Corning Tropol Corp.

Rochester Riverside Convention Center

Rochester Riverside Convention Center
123 East Main St, Rochester, NY 14604-1619
Tel : (585) 232-7200, Fax: (585) 232-1510,
www.rrcc.com

Registration Hours

*Rochester Riverside Convention Center
Registration*

Convention Center Galleria

Monday–Wednesday 7:30 am to 5:00 pm
Thursday 7:30 am to 4:00 pm

Interactive Poster Session (for Technical Attendees)

Grand Lilac Ballroom

Wednesday 5:00 to 6:30 pm
Technical Attendees are requested to wear their
registration badges for admittance.

Refreshments Sponsored by:



Authors must be present for discussion during the
Interactive Poster Session.

Message Center

Rochester Riverside Convention Center, located
near registration. Messages will be taken during
registration hours Monday through Thursday by
calling **585 770-2360**

Don't miss the cutting-edge exhibition

Optifab Exhibition is an international event showcasing optical manufacturing technology, including operations, machines, tools, materials, instrumentation, metrology, and processes. Don't miss the chance to do months of product research and take advantage of teaming opportunities at *the* premier optical fabrication exhibition.

Exhibition Hours

*Rochester Riverside Convention Center
Empire Hall*

Tuesday 15 May 10:00 am to 5:00 pm
Wednesday 16 May 10:00 am to 5:00 pm
Thursday 17 May 10:00 am to 4:00 pm



WiFi

Complimentary Internet Wireless Access

Sponsored by:



Complimentary wireless access to the Internet for all conference attendees will be available. Bring 802.11b wireless-enabled laptops or PDAs.

Coffee Breaks at the Convention Center

Complimentary coffee will be served each day of the conference at approximately 10:30 am and 3:00 pm. Please check the technical conference listings in the onsite program for exact times and locations.

Wednesday Coffee Break Sponsored by:



Audio/Video/Digital Recording Policy

Due to copyright restrictions, strictly no recordings of any kind are permitted without prior written consent of the presenter in any conference session, short course or posters. Consent forms are available at the SPIE Audiovisual Desk and anyone wishing to record must have a written consent form signed and filed for each presenter being recorded. Individuals not complying with this policy will be asked to leave a given session and asked to surrender their film or recording media.

Ground Transportation



Hertz Car Rental has been selected as the official car rental agency for this Symposium. To reserve a car at the reduced conference rates, use the **Hertz Meeting Code CV# 029B0010**. Book on-line at www.hertz.com.

For Authors & Presenters

Speaker Audiovisual Equipment

All conference rooms will have a projector, screen, lapel microphone, and laser pointer.

Poster Set up and Viewing

Set Up: Wednesday 8:00 am to 4:00 pm

Authors are encouraged to set up your posters by morning coffee break on Wednesday. Posters will be available for viewing throughout the day on Wednesday.

Poster paper numbers will be pre-posted on the poster boards and push pins will be provided. Presenters who have not placed their poster presentations on their assigned board by 5:00 pm on Wednesday will be considered a "no show."

Presenters should remove their posters at the end of the interactive poster session. Posters not removed will be considered unwanted and will be discarded.

POSTER PREVIEWS

Poster authors are invited to make an oral 3-minute poster preview presentation in the conference room. Please check the program for the timing of these poster previews.

Important Laser Pointer Safety Information

- SPIE supplies tested and safety approved laser pointers for all conference meeting rooms, and for short course rooms if instructors request one. For safety reasons, SPIE requests that presenters use our provided laser pointers available in each meeting room.
- If using your own laser pointer, have it tested at your facility to make sure it has <5 mW power output. Laser pointers in Class II and IIIa (<5 mW) are eye safe if power output is correct – but don't automatically trust the labeling. Commercially available laser pointers, red or green (or any color), could be incorrectly labeled as to their wavelength and power output.
- Presenters intending to use their own laser pointer for presentations are required to come to the Audiovisual Desk onsite and test their pointer on our power meter. If the pointer fails the safe power level you may not use the pointer at the conference. You will be required to sign a waiver releasing SPIE of any liability for use of potentially non-safe laser pointers.
- **Use of a personal laser pointer at an SPIE event represents user's acceptance of liability for use of a non-SPIE supplied laser pointer device.** Misuse of any laser pointer could lead to eye damage. In California, it is a criminal misdemeanor to shine a laser pointer at individuals "who perceive they are at risk."

Conference Chairs



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Coastal Optical Systems
Inc. (USA)



Matthias Pfaff,
OptoTech Optikmaschinen
GmbH (Germany)

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- Martin J. Valente,** College of Optical Sciences/The Univ. of Arizona Center (USA)
- Kirk Warden,** LaCroix Optical Co. (USA)



Technical Program

Room: Highland Room C
Monday-Thursday 14-17 May 2007

Optifab 2007

Conference Chairs: **James J. Kumler**, Coastal Optical Systems Inc.; **Matthias Pfaff**, OptoTech Optikmaschinen GmbH (Germany)

Program Committee: **Thomas Battley**, Photonics Industry Association of New York, Inc.; **Michael J. Bechtold**, OptiPro Systems; **Christopher T. Cotton**, ASE Optics, Inc.; **Walter C. Czajkowski**, Edmund Optics Inc.; **Thomas Danger**, Schneider GmbH & Co. KG (Germany); **Toshihide Dohi**, Optiworks, Inc. (Japan); **Edward M. Fess**, Univ. of Rochester; **Thomas Godin**, Satisloh North America Inc.; **Donald Golini**, QED Technologies Inc.; **Heidi Hofke**, OptoTech Optical Machinery Inc.; **David Keller**, Universal Photonics Inc.; **Michael F. Kuechel**, Zygo Corp. (Germany); **Hans Lauth**, JENOPTIK Laser, Optik, Systeme GmbH (Germany); **Arne Lindquist**, QED Technologies Inc. and Schneider GmbH & Co. KG (Germany); **Michael P. Mandina**, Optimax Systems, Inc.; **Paul Meier-Wang**, AccuCoat Inc.; **Michael N. Naselaris**, Stefan Sydor Optics, Inc.; **John J. Nemecek**, FISBA OPTIK LLC; **Basilio Nesti**, Naked Optics Corp.; **Robert F. Novak**, Monroe Community College/APOMA; **Yazid Tohme**, Moore NanoTechnology Systems, LLC; **Paul R. Tolley**, Syntec Technologies Inc.; **Martin J. Valente**, College of Optical Sciences/The Univ. of Arizona; **Kirk Warden**, LaCroix Optical Co.

Monday 14 May

SESSION 1

Room: Highland Room C Mon. 10:00 to 11:45 am

Design for Manufacturability and Opto-mechanical Design

Chair: **James J. Kumler**, Coastal Optical Systems Inc.

10:00 am: **Aspheric design for manufacturability**, C. B. Kreisler, Kreisler Optics, Ltd. [TD04-01]

10:20 am: **Error budget for the metrology of the JWST MIRI spectrometer pre-optics**, S. P. Martin, P. M. Morantz, P. R. Shore, Cranfield Univ. (United Kingdom) [TD04-02]

10:40 am: **Lenses for laser material processing**, U. Krueger, O. R. Falkenstoerfer, L. Koerner, H. Lauth, S. Müller-Pfeiffer, U. Schuhmann, JENOPTIK Laser, Optik, Systeme GmbH (Germany) [TD04-03]

11:00 am: **Slope error tolerances for optical surfaces (Invited Paper)**, J. R. Rogers, Optical Research Associates [TD04-04]

11:30 am: Poster Previews (3-minute presentations)

The following Oral Poster Previews will be on display in the Grand Lilac Ballroom on Wednesday. Authors will be present during the Interactive Poster Session for discussion from 5:00 to 6:30 pm.

- ✓ **Comparison of two methods for optical performance compensation via moving lens elements**, K. Hanford, B. M. McMaster, Corning Tropol Corp. [TD04-44]
- ✓ **Research of spacing stability of tunable F-P filter**, S. Shi, Shanghai Institute of Optics and Fine Mechanics (China) [TD04-45]
- ✓ **Design and development of a demultiplexer for WDM over POF**, U. H. P. Fischer-Hirchert, M. Haupt, Hochschule Harz (Germany) [TD04-46]
- ✓ **Stability design and analysis of target chamber**, H. B. Huang, Shanghai Institute of Optics and Fine Mechanics (China) [TD04-47]
- ✓ **Compact optical rotation sensor using CCD array**, V. V. Raja, Sardar Vallabhbhai National Institute of Technology (India); B. Srinivasan, Indian Institute of Technology Madras (India) [TD04-48]
- ✓ **Optomechanics of a trigonal stress double focus system**, A. K. Spilman, T. G. Brown, Univ. of Rochester [TD04-78]

Lunch Break 11:45 am to 12:45 pm

SESSION 2

Room: Highland Room C Mon. 12:45 to 2:55 pm

Optical Fabrication I

Chair: **Robert F. Novak**, Monroe Community College

12:45 pm: **Machining of paraboloidal mirrors**, U. P. Birnbaum, J. Greese, JENOPTIK Laser, Optik, Systeme GmbH (Germany) [TD04-49]

1:05 pm: **Design and development of a novel computer controlled power device for electrical-assisted optical grinding**, F. Patham, A. Geiss, R. Rascher, P. Sperber, M. Schinhaerl, E. G. Pitschke, Fachhochschule Deggendorf (Germany) ... [TD04-06]

1:25 pm: **Micromechanical contributions to material removal**, S. N. Shafir, J. C. Lambropoulos, S. D. Jacobs, Univ. of Rochester [TD04-07]

1:45 pm: **Chemical mechanical planarization for high precision optics**, F. Batllo, Cabot Microelectronics Corp. [TD04-08]

2:05 pm: **Densification's effect on material removal mechanism**, K. Xin, X-Ray Optical Systems, Inc.; J. C. Lambropoulos, Univ. of Rochester [TD04-09]

2:25 pm: **Current progress and future trends of optical manufacturing and testing technologies in China (Invited Paper, Manuscript Only)**, L. Yang, Institute of Optics and Electronics (China) [TD04-05]

Coffee Break 2:55 to 3:15 pm

SESSION 3

Room: Highland Room C Mon. 3:15 to 4:30 pm

Optical Fabrication II: Polishing

Chair: **Martin J. Valente**, College of Optical Sciences/The Univ. of Arizona

3:15 pm: **Reactive Atom Plasma (RAP™) process for fabricating damage-free SiC optics**, Y. Verma, RAP Industries Inc. [TD04-10]

3:35 pm: **Algorithms and contact mechanics models for ultraform finishing (UFF)**, C. Bouvier, S. M. Gracewski, S. J. Burns, Univ. of Rochester [TD04-12]

3:55 pm: **Methods for polishing large sapphire windows**, J. S. Kane, Computer Optics, Inc. [TD04-13]

4:15 pm: Poster Previews (3-minute presentations)

The following Oral Poster Previews will be on display in the Grand Lilac Ballroom on Wednesday. Authors will be present during the Interactive Poster Session for discussion from 5:00 to 6:30 pm.

- ✓ **Superprecision optical surfaces and their investigation by the atomic force microscopy, light and X-ray scattering and white light interferometry**, V. V. Azarova, POLYUS Research & Development Institute (Russia); V. E. Asadchicov, A.V. Shubnikov Institute of Crystallography (Russia); Y. D. Golyaev, POLYUS Research & Development Institute (Russia); M. L. Zhanavskina, A.V. Shubnikov Institute of Crystallography (Russia); G. Y. Kolodniy, N. V. Tichmenev, POLYUS Research & Development Institute (Russia) [TD04-11]
- ✓ **Double-sided lapping orbits, unwrapped**, R. Williamson, Ray Williamson Consulting [TD04-50]
- ✓ **Off-the-shelf PTFE as a fine polishing pad**, B. A. Mullany, E. Corcoran, The Univ. of North Carolina at Charlotte [TD04-51]
- ✓ **Vibe: a new process for high-speed polishing of optical elements**, C. R. Klinger, Optimax Systems, Inc. [TD04-52]
- ✓ **Pitch polishing of silica: correlation between material removal rates and surface finishes**, B. A. Mullany, A. Landis, The Univ. of North Carolina at Charlotte; P. G. Murray, W. I. Roberts, Nanophase Technologies Corp.; E. Paul, The Richard Stockton College of New Jersey [TD04-53]

SESSION 4

Room: Highland Room C Mon. 4:30 to 6:00 pm

Aspheric Polishing

Chair: James J. Kumler, Coastal Optical Systems Inc.

- 4:25 pm: **Advances in finishing using magnetorheological (MR) jet technology**, J. Tracy, W. I. Kordonski, A. B. Shorey, M. Tricard, QED Technologies Inc. . [TD04-14]
- 4:45 pm: **Material removal model for magnetorheological finishing (MRF) of optical glasses with nanodiamond MR fluid**, J. E. DeGroot, A. E. Marino, J. P. Wilson, A. L. Bishop, S. D. Jacobs, Univ. of Rochester [TD04-15]
- 5:05 pm: **Flexible precision asphere manufacturing**, P. Dumas, S. D. O'Donohue, G. W. Forbes, M. Tricard, QED Technologies Inc. [TD04-16]
- 5:25 pm: **Wheel polishing and active fluid jet polishing: fabrication of complex optical surfaces**, R. Mandler, OptoTech GmbH (Germany) [TD04-17]
- 5:45 pm: **Magnetorheological Finishing (MRF®) of freeform optics**, C. A. Hall, A. Jones, W. J. Messner, R. W. Hallock, QED Technologies Inc. [TD04-18]

Tuesday 15 May

SESSION 5

Room: Highland Room C Tues. 8:00 to 10:40 am

Aspheric Metrology I

Chair: Matthias Pfaff, OptoTech GmbH (Germany)

- 8:00 am: **Encompassing spatial frequency requirements in optical metrology (Invited Paper)**, R. N. Youngworth, K. S. Youngworth, Ball Aerospace & Technologies Corp. [TD04-19]
- 8:20 am: **Make it like you use it**, B. Light, Optimax Systems, Inc. [TD04-20]
- 8:40 am: **Measuring surface slope error on precision aspheres**, J. J. Kumler, Coastal Optical Systems Inc. [TD04-21]
- 9:00 am: **High precision interferometer for measuring mid-spatial frequency departure in free form optics**, L. L. Deck, Zygo Corp. [TD04-22]
- 9:20 am: **Accurate interferometric measurements of mild aspheres without null correction**, P. E. Murphy, J. F. Fleig, S. D. O'Donohue, G. M. DeVries, QED Technologies Inc. [TD04-23]
- 9:40 am: **Measurement of aspheric surfaces with 3D-deflectometry**, I. Scheele, S. Krey, Trioptics GmbH (Germany) [TD04-24]
- 10:00 am: **Interferometric measurement of rotationally symmetric aspheric surfaces**, M. F. Kuechel, Zygo Corp. (Germany) [TD04-25]
- 10:20 am: **A new use of computer generated holograms as a tool to shape the beam in interferometric testing**, C. G. Kuechel, R. Schreiner, JENOPTIK Laser, Optik, Systeme GmbH (Germany) [TD04-26]

Wednesday 16 May

SESSION 6

Room: Highland Room C Wed. 8:00 to 10:30 am

Aspheric Metrology II

Chair: Michael F. Kuechel, Zygo Corp. (Germany)

- 8:00 am: **PSD data analysis and algorithm development (Invited Paper)**, J. E. Hayden, ITT Space Systems LLC [TD04-27]
- 8:30 am: **Software null design and usage (Presentation Only)**, S. M. Arnold, Diffraction International Ltd. [TD04-28]
- 8:50 am: **Balancing measurement time and uncertainty when stitching in production environments**, G. M. DeVries, P. E. Murphy, QED Technologies Inc. [TD04-29]
- 9:10 am: **Compensation of vibration errors in high-performance interferometry**, L. L. Deck, Zygo Corp. [TD04-30]
- 9:30 am: **Aspheric lens tester with Shack-Hartmann sensor**, A. K. Ruprecht, I. Scheele, S. Krey, Trioptics GmbH (Germany) [TD04-31]
- 9:50 am: **On-axis, non-contact measurement of glass thicknesses and airgaps in optical systems with submicron accuracy**, R. C. Wilhelm, A. Courteville, F. Garcia, F. de Vecchi, M. Saracco, FOGALE nanotech (France) [TD04-32]
- 10:10 am: **Real-time MTF measurement of CMOS and CCD cameras**, J. Heinisch, E. Dumitrescu, S. Krey, Trioptics GmbH (Germany) [TD04-33]
- Coffee Break 10:30 to 11:00 am

SESSION 7

Room: Highland Room C Wed. 11:00 am to 12:20 pm

Fabrication (Other)

Chair: Walter C. Czajkowski, Edmund Optics Inc.

- 11:00 am: **Centration expressions and conversions**, R. Williamson, Ray Williamson Consulting [TD04-34]
- 11:20 am: **Highest precision centering error measurement**, J. Heinisch, E. Dumitrescu, S. Krey, Trioptics GmbH (Germany) [TD04-35]
- 11:40 am: **Automatic centring and bonding of lenses**, S. Krey, J. Heinisch, E. Dumitrescu, Trioptics GmbH (Germany) [TD04-36]
- 12:00 pm: **Poster Previews (3-minute presentations)**
The following Oral Poster Previews will be on display in the Grand Lilac Ballroom on Wednesday. Authors will be present during the Interactive Poster Session for discussion from 5:00 to 6:30 pm.
- ✓ **Temperature variation of pitch in a pitch pot**, C. R. Klinger, Optimax Systems, Inc.; S. Droste, Univ. Münster (Germany) [TD04-55]
- ✓ **Freeform optics fabrication by diamond turning**, W. Jiang, LPI Precision Optics Ltd. [TD04-56]
- ✓ **Software tools for studying optical manufacturability with modern monochromatic monitoring devices**, A. V. Tikhonravov, M. K. Trubetskov, M.V. Lomonosov Moscow State Univ. (Russia); J. D. T. Kruschwitz, JK Consulting and OptiLayer, Ltd. (Russia); A. Zoeller, H. Hagedorn, B. Romanov, M. Boos, Leybold Optics GmbH (Germany) [TD04-57]
- ✓ **Silicon-silicon nitride coatings for reduced angle and polarization sensitivity**, J. Mosier, B. Laison, Deposition Sciences, Inc. [TD04-58]
- ✓ **Stokes vector determination of polarized light propagation in optical turbid medium**, S. Firdous, Sr., Pakistan Institute of Engineering and Applied Sciences (Pakistan) [TD04-60]
- ✓ **Photopolymers containing triazine monomers for holographic recording**, E. Kim, Yonsei Univ. (South Korea) [TD04-62]
- Lunch Break 12:20 to 1:00 pm

SESSION C1

Room: Highland Room C Wed. 1:00 to 2:10 pm

Commercial Presentations on Optical Materials and Optics

Chairs: **James M. Sydor**, Stefan Sydor Optics, Inc.;
Richard A. Nasca, Corning, Inc.

- 1:00 pm: **Optical glass** (*Presentation Only*), C. Ghio, Ohara Corp. [TD04-63]
- 1:10 pm: **Precision molded aspherical lenses**, H. Vogt, SCHOTT AG (Germany) [TD04-64]
- 1:20 pm: **New optical glasses**, B. Hladik, SCHOTT AG (Germany) [TD04-65]
- 1:30 pm: **IR optics for defense, security, and civil applications from JENOPTIK Germany**, M. Esselbach, T. Weyh, S. Müller-Pfeiffer, O. R. Falkenstoerfer, W. Seiferth, H. Lauth, JENOPTIK Laser, Optik, Systeme GmbH (Germany) [TD04-66]
- 1:40 pm: **Actual quality status of CaF₂ and fused silica (Lithosil) for microlithography and laser applications** (*Presentation Only*), S. Strohm, SCHOTT North America, Inc. [TD04-82]
- 1:50 pm: **Lightweight, low cost, replicated, corrugated glass mirrors** (*Presentation Only*), D. N. Strafford, ITT Corp. [TD04-83]
- Panel Discussion 2:00 to 2:10 pm

SESSION C2

Room: Highland Room C Wed. 2:10 to 3:20 pm

Commercial Presentations on Fabrication and Fabrication Equipment

Chairs: **James M. Sydor**, Stefan Sydor Optics, Inc.;
Richard A. Nasca, Corning, Inc.

- 2:10 pm: **UltraForm Finishing (UFF) a 5-axis computer controlled precision optical component grinding and polishing system** (*Presentation Only*), M. J. Bechtold, D. E. Mohring, OptiPro Systems; E. M. Fess, Univ. of Rochester [TD04-68]
- 2:20 pm: **Solutions for the fabrication of freeform optical surfaces** (*Presentation Only*), Y. E. Tohme, R. J. Cassin, Moore NanoTechnology Systems, LLC [TD04-69]
- 2:30 pm: **An MRF[®] machine in every shop** (*Presentation Only*), M. A. DeMarco, R. W. Hallock, QED Technologies Inc. [TD04-70]
- 2:40 pm: **Profit through predictability: the MRF difference at Optimax**, B. Light, Optimax Systems, Inc. [TD04-71]
- 2:50 pm: **Latest technology on ultrasonic cleaning**, H. U. Hofstetter, Ultrasonic Cleaning Machines AG (Switzerland) [TD04-72]
- 3:00 pm: **Training resource for precision opticians**, R. Williamson, Ray Williamson Consulting [TD04-73]
- Panel Discussion 3:10 to 3:20 pm
- Coffee Break 3:20 to 3:40 pm

SESSION C3

Room: Highland Room C Wed. 3:40 to 4:40 pm

Commercial Presentations on Metrology Equipment

Chairs: **James M. Sydor**, Stefan Sydor Optics, Inc.;
Richard A. Nasca, Corning, Inc.

- 3:40 pm: **Metrology of micron-scale features within multilayered dielectric structures using scanning low-coherence dual interferometry (SLCDI)** (*Presentation Only*), D. W. Diehl, C. J. Ditchman, C. T. Cotton, ASE Optics, Inc. [TD04-74]
- 3:50 pm: **Accurate and high resolution metrology for manufacturing plano, spherical, and aspheric surfaces** (*Presentation Only*), S. D. O'Donohue, P. E. Murphy, M. Tricard, QED Technologies Inc. [TD04-75]
- 4:00 pm: **Contact and non-contact aspheric, deep parabolic, Ogive measurement systems** (*Presentation Only*), D. E. Mohring, M. J. Bechtold, J. P. Meisenzahl, S. Bambrick, OptiPro Systems [TD04-76]
- 4:10 pm: **Optimizing your cleanroom dollars** (*Presentation Only*), R. Kraft, R. Kraft, Inc. [TD04-77]
- 4:20 pm: **Simultaneous phase shifting Fizeau interferometer: comparison of measurements with temporal phase shifting interferometer** (*Presentation Only*), P. Szwajkowski, Engineering Synthesis Design, Inc. [TD04-80]
- Panel Discussion 4:30 to 4:40 pm

Interactive Poster Session

Grand Lilac Ballroom

Wednesday 5:00 to 6:30 pm

Technical Attendees are requested to wear their registration badges for admittance. Poster authors will be present to answer questions.

Refreshments Sponsored by:



Thursday 17 May

SESSION 8

Room: Highland Room C Thurs. 8:00 to 10:00 am

Diamond Turning and Molding

Chair: **Kathleen A. Richardson**, Clemson Univ.

- 8:00 am: **Advances in the production of freeform optical surfaces**, Y. E. Tohme, S. S. Luniya, Moore NanoTechnology Systems, LLC [TD04-37]
- 8:20 am: **Manufacturing of a freeform phase plate for suppression of diffraction in an astronomical telescope**, G. E. Davis, II-VI Infrared; M. A. Kenworthy, The Univ. of Arizona/Steward Observatory; A. R. Hedges, II-VI Infrared [TD04-38]
- 8:40 am: **Microforging technique for fabrication of low roughness mold masters for injection molded lens arrays**, C. R. Forest, M. A. Saez, I. W. Hunter, Massachusetts Institute of Technology [TD04-39]
- 9:00 am: **Prediction of birefringence in plastic moldings**, A. S. Bakharev, C. Friedl, F. Costa, P. Kennedy, Moldflow Plastics Labs. (Australia) [TD04-40]
- 9:20 am: **Study of the interactions between the glass and mold during the molding process** (*Presentation Only*), S. W. Gaylord, L. Petit, R. Burtovyy, I. Luzinov, K. Richardson, Clemson Univ. [TD04-41]
- 9:40 am: **Precision glass molding technical brief**, B. Bundschuh, Rochester Precision Optics, LLC [TD04-79]

SESSION 9

Room: Highland Room C Thurs. 10:00 to 11:00 am

Coatings and Gratings

Chair: **Alexis K. Spilman**, Univ. of Rochester

- 10:00 am: **Optical thin films applied by single-target reactive magnetron sputtering**, M. A. Peter, L. Jordi, A. Wetter, F. Breme, Satisloh Photonics AG (Switzerland) [TD04-42]
- 10:20 am: **Thin film extraction from scanning white light interferometry**, D. I. Mansfield, Taylor Hobson Ltd. (United Kingdom) [TD04-81]
- 10:40 am: **Optical characterization models for dispersion analysis of substrates and films with abrupt absorption transitions** (*Presentation Only*), J. D. T. Kruschwitz, JK Consulting; A. V. Tikhonravov, M. K. Trubetskov, M.V. Lomonosov Moscow State Univ. (Russia) [TD04-67]



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Optical Coating Design and Analysis for High Manufacturability

NEW

SC842

Monday 8:30 am to 12:30 pm

Course level: Intermediate CEU .35 \$285 / \$330 USD

This course provides attendees with the basic principles of constructing the most practical optical coating design. The main sources of production errors are considered and estimated. Choosing appropriate monitoring strategies for successful production of optical coatings of various types is discussed. The course demonstrates how post-production optical characterization is used to increase production yield. The course presents the potential benefits of computational manufacturing as a tool for reducing production costs and raising design manufacturability.

INSTRUCTOR: Jennifer Kruschwitz is a Sr. Optical Coating Engineer and President of her coating design firm, JK Consulting. She received her Bachelors and Masters Degrees in Optics from the University of Rochester and has been working in the field of optical interference coatings since 1988. Prior to forming JK Consulting in 1998, she worked for Litton/Itek Optical, the Laboratory for Laser Energetics at the University of Rochester, and Bausch & Lomb. Her professional expertise includes lighting and display applications for the entertainment and medical industries, optical coatings for laser fusion, and defense projects for the U.S. government. She is an active volunteer for the OSA and SPIE, and serves as a contributing editor for Optics and Photonics News.

COURSE PRICE INCLUDES demonstration copies of the thin film software tools OptiLayer, OptiRE, and OptiChar to reproduce the in-class examples.

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SC721

Monday 8:30 am to 5:30 pm

Course level: Intermediate CEU .65 \$460 / \$545 USD

This course will provide the attendee with the fundamentals of single point diamond turning (SPDT) and its applications for manufacturing optical elements and systems. An introduction to fundamental optical design principles is included for better understanding of aberration effects and the advantages of aspheric and diffractive surfaces, which can be routinely generated by the process of diamond turning. Materials suitable for the process (metals, crystals and plastics) will be discussed. The limits of precision of SPDT in terms of surface figure, finish and irregularity will be covered. The course examines alternative optical configurations, not suitable for conventional construction, such as monolithic collimators and "snap-together" optomechanical assemblies. Included are several examples demonstrating how such elements and systems are designed to fully take advantage of this manufacturing method.

INSTRUCTOR: Max Riedl is currently technical advisor to several U.S. corporations. He holds a Dipl Ing. (F.H.) degree in precision mechanics and optics and has worked in the field of mathematical and electro-optical instruments for more than 50 years. He is a Fellow of SPIE and the author of the SPIE Tutorial Text *Optical Design Fundamentals for Infrared Systems* (TT48). This tutorial text includes also a chapter on Diamond Turning of optics.

Cost-Conscious Tolerancing of Optical Systems

SC720

Tuesday 1:30 to 5:30 pm

Course level: Introductory CEU .35 \$280 / \$325 USD

The purpose of this course is to present concepts, tools, and methods that will help attendees determine optimal tolerances for optical systems. Topics in the course apply to all volumes of systems being developed—from single systems to millions of units. The course provides a background to effective tolerancing with discussions on variability and relevant applied statistics. Tolerance analysis and assignment with strong methodology is then covered. The course concludes by giving an introduction to useful tools including design of experiments and statistical process control. References and examples are included to help practicing researchers, designers, engineers, and technicians practically apply the concepts to plan, design, engineer, and build high-quality cost-competitive optical systems.

INSTRUCTOR: Richard Youngworth is an optical engineer at Ball Aerospace & Technologies Corp. in Boulder, Colorado. He has a B.S. in electrical engineering from the University of Colorado at Boulder and earned his Ph.D. in Optics at the University of Rochester by researching tolerance analysis of optical systems.

Understanding Scratch and Dig Specifications

SC700

Tuesday 8:30 am to 12:30 pm

Course level: Introductory CEU .35 \$330 / \$375 USD

Surface imperfection specifications (i.e. Scratch-Dig) are among the most misunderstood, misinterpreted, and ambiguous of all optics component specifications. This course provides attendees with an understanding of the source of ambiguity in surface imperfection specifications, and provides the context needed to properly specify surface imperfections using a variety of specification standards, and to evaluate a given optic to a particular level of surface imperfection specification. The course will focus on the differences and application of the Mil-PRF-13830, ISO 10110-7, and BSR/OP1.002. Many practical and useful specification examples are included throughout, as well as a hands-on demonstration on visual comparison evaluation techniques.

INSTRUCTOR: David Aikens is the Director of Metrology Operations at Zygo Corporation, and has been designing and specifying optics for more than 20 years. He has been active in the development of surface imperfection standards since 1996, and is currently serving as Chairman of the Board for the ANSI accredited Optics and Electro-Optics Standards Council, and is a technical advisor for the American delegation to ISO TAG TC172.

COURSE PRICE INCLUDES a copy of the latest ANSI approved surface imperfections specification standard.

Optifab 2007

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Conference and Courses: **14–17 May 2007**

Exhibition: **15–17 May 2007**

Rochester Riverside Convention Center
Rochester, New York USA

Courses

Aspheric Optics: Design, Fabrication, and Test

SC552

Tuesday 1:30 to 5:30 pm

Course level: Introductory CEU .35 \$355 / \$400 USD

This course will provide attendees with a broad and useful understanding of aspheric surfaces and components. Aspheric or non-spherical surfaces in a lens or mirror system can bring significant benefits to the optical performance. This is not without the liabilities of added cost, delivery time, and even producibility. The course will begin with lens design, and specifically how and when to incorporate aspherics into a variety of lens design forms. We discuss what aspherics will do for a design, and also what they will not do. We then will discuss how aspheric surfaces are manufactured along with recommendations on how to specify aspherics. Several methods for predicting performance for systems with asphere induced wavefront irregularities will be shown. We also will discuss the testing of aspherics.

INSTRUCTOR: Robert Fischer is President and founder of OPTICS 1, Inc., and has been involved in optical system design and engineering for over 25 years. Fischer is co-author of *Optical System Design* co-published by SPIE and McGraw-Hill. He is also a past president of SPIE.

COURSE PRICE INCLUDES the text, *Optical System Design* (SPIE, 2000), by Robert E. Fischer.

Optical Manufacturing Overview

SC350

Monday 8:30 am to 5:30 pm

Course level: Introductory CEU .65 \$460 / \$545 USD

This course provides a basic understanding of the methodology and processes used in the fabrication of precision optical elements. Emphasis is placed on the selection and use of tooling, materials and equipment used in the manufacturing process with specific examples.

INSTRUCTOR: Robert Novak has taught Optical Engineering for over thirty years at Monroe Community College located in Rochester, New York. He is currently Chairman of the Engineering Technology Department and has headed the Optical Systems Technology group for over twenty years. His primary course responsibilities are in the areas of optical manufacturing and optical testing.

Optical Alignment Mechanisms

SC220

Wednesday 1:30 to 5:30 pm

Course level: Intermediate CEU .35 \$280 / \$325 USD

This is a practical "how to" course dealing with the design and fabrication of precision optical alignment and adjustment devices. The course uses example optical systems to identify typical alignment requirements and provides a catalog of proven adjustment techniques.

INSTRUCTOR: Robert Guyer specializes in the design of lasers, stable optical mounts, gimballed systems, and precision mechanisms. Mr. Guyer is an Engineering Fellow at BAE Systems in Nashua, New Hampshire, and has over 40 years military, space, and commercial opto-mechanical product development experience with BAE Systems, RCA, GE, Lockheed Martin, and AFAB Group. He is a registered Professional Engineer and committed Corvette enthusiast.

Modern Optical Testing

SC212

Wednesday 8:30 am to 12:30 pm

Course level: Intermediate CEU .35 \$280 / \$325 USD

This course describes the basic interferometry techniques used in the evaluation of optical components and optical systems. It discusses interferogram interpretation, computer analysis, and phase-shifting interferometry, as well as various commonly used wavefront-measuring interferometers. The instructor describes specialized techniques such as testing windows and prisms in transmission, 90-degree prisms and corner cubes, measuring index inhomogeneity, and radius of curvature. Testing cylindrical and aspheric surfaces, determining the absolute shape of flats and spheres, and the use of infrared interferometers for testing ground surfaces are also discussed. The course also covers state-of-the-art direct phase measurement interferometers.

INSTRUCTOR: James Wyant is Dean of the College of Optical Sciences and Professor of Optical Sciences at the University of Arizona. He was a founder of the WYKO Corporation and served as its president from 1984 to 1997. Dr. Wyant was the 1986 President of SPIE.

Structural Adhesives for Optical Bonding

SC015

Tuesday 8:30 am to 12:30 pm

Course level: Intermediate CEU .35 \$280 / \$325 USD

Optomechanical systems require secure mounting of optical elements. This important aspect of the design can cause a production to stop if sound engineering is not applied. A wide variety of adhesives are discussed with respect to their relevant properties. Design considerations, differing mounting techniques, production concerns, and reliability are reviewed. The instructor gives success and failure case histories.

INSTRUCTOR: John Daly has been a consultant for the past 10 years. He has experience in the applications of adhesives to our industry. Daly has more than 20 years of experience in academia, aerospace, medical, commercial, and industrial fields. He has a B.S. in Mechanical Engineering Ph.D. in Applied Physics. His exposure to these areas for applications of laser, electro-optic, and photonic technologies has covered research, development, production, and management.