## Contents

ix  Conference Committee  

xi  Introduction  

xiii The history of telescopes and binoculars: an engineering perspective (Plenary Paper) [8129-100]  
J. E. Greivenkamp, D. L. Steed, College of Optical Sciences, The Univ. of Arizona (United States)

### SESSION 1  MANUFACTURING OPTICS FOR ASTRONOMY I

8126 03 Optical manufacturing and testing requirements identified by the NASA Science Instruments, Observatories, and Sensor Systems Technology Assessment (Invited Paper) [8126-01]  
H. P. Stahl, NASA Marshall Space Flight Ctr. (United States); R. Barney, NASA Goddard Space Flight Ctr. (United States); J. Bauman, NASA Ames Research Ctr. (United States); L. Feinberg, NASA Goddard Space Flight Ctr. (United States); D. McCleese, Jet Propulsion Lab. (United States); U. Singh, NASA Langley Research Ctr. (United States)

8126 04 Technologies for producing segments for extremely large telescopes [8126-02]  
D. Walker, OptIC Glyndwr Ltd. (United Kingdom), Univ. College London (United Kingdom), and Zeeko Ltd. (United Kingdom); C. Atkins, OptIC Glyndwr Ltd. (United Kingdom) and Univ. College London (United Kingdom); I. Baker, R. Evans, S. Hamidi, P. Harris, OptIC Glyndwr Ltd. (United Kingdom); H. Li, Univ. College London (United Kingdom); W. Messelink, Zeeko Ltd. (United Kingdom); J. Mitchell, Cranfield Univ. (United Kingdom); M. Parry-Jones, P. Rees, G. Yu, OptIC Glyndwr Ltd. (United Kingdom)

8126 06 ZERODUR for stress mirror polishing [8126-04]  
R. Jedamzik, C. Kunisch, T. Westerhoff, SCHOTT AG (Germany)

8126 07 Design and fabrication of a 3m class light weighted mirror blank for the E-ELT M5 [8126-05]  
R. Jedamzik, V. Seibert, A. Thomas, T. Westerhoff, SCHOTT AG (Germany); M. Müller, M. Cayrel, European Southern Observatory (Germany)

### SESSION 2  MANUFACTURING OPTICS FOR ASTRONOMY II

8126 09 Piezoelectric deformable mirror based on monolithic PVDF membranes [8126-07]  
G. A. Finney, Kratos Defense and Security Solutions, Inc. (United States); K. Spradley, Advanced Optical Systems, Inc. (United States); B. Farmer, L. Smith, B. Patrick, NeXolve Corp. (United States)

8126 0A Progress in 4m class ZERODUR mirror production [8126-08]  
T. Westerhoff, S. Gruen, R. Jedamzik, C. Klein, T. Werner, A. Werz, SCHOTT AG (Germany)
8126 0B **Open-source data analysis and visualization software platform: SAGUARO** [8126-09]
D. W. Kim, B. J. Lewis, J. H. Burge, College of Optical Sciences, The Univ. of Arizona (United States)

8126 0C **Measuring the residual stress of transparent conductive oxide films on PET by the double-beam shadow Moiré interferometer** [8126-10]
H.-C. Chen, K.-T. Huang, Y.-M. Lo, H.-Y. Chiu, G.-J. Chen, National Yunlin Univ. of Science and Technology (Taiwan)

**SESSION 3  TESTING I**

8126 0D **MicroFinish Topographer: surface finish metrology for large and small optics** [8126-11]
R. E. Parks, Optical Perspectives Group, LLC (United States)

8126 0E **Scanning Long-wave Optical Test System: a new ground optical surface slope test system** [8126-12]
T. Su, W. H. Park, R. E. Parks, P. Su, J. H. Burge, College of Optical Sciences, The Univ. of Arizona (United States)

8126 0F **Phase-shifting Zernike interferometer wavefront sensor** [8126-13]
J. K. Wallace, S. Rao, Jet Propulsion Lab. (United States); R. M. Jensen-Clem, Massachusetts Institute of Technology (United States); G. Serabyn, Jet Propulsion Lab. (United States)

8126 0H **Dynamic surface roughness profiler** [8126-15]
B. Kimbrough, N. Brock, J. Millerd, 4D Technology Corp. (United States)

**SESSION 4  MANUFACTURING I**

8126 0I **Cryo-stability of HB-Cesic optics** [8126-16]
M. Krödel, ECM Engineered Ceramic Materials GmbH (Germany)

8126 0J **Analysis of fine-grinding techniques in terms of achievable surface qualities** [8126-17]
O. Fähnle, K. Hauser, FISBA OPTIK AG (Switzerland)

8126 0K **Fabricating and testing complex optical elements with high precision** [8126-18]
H. Wang, V. Giggei, G. Derst, T. Koch, Carl Zeiss Jena GmbH (Germany)

8126 0L **Analytical process design for chemo-mechanical polishing of glass aspheres** [8126-19]
D. Waechter, O. Dambon, F. Klocke, Fraunhofer Institute for Production Technology (Germany)

**SESSION 5  TESTING OPTICS FOR ASTRONOMY**

8126 0M **Non-contact profilometry of E-ELT segments at OptiC Glyndwr** [8126-21]
C. Atkins, Univ. College London (United Kingdom) and OptiC Glyndwr Ltd. (United Kingdom); J. Mitchell, Cranfield Univ. (United Kingdom) and OptiC Glyndwr Ltd. (United Kingdom); P. Rees, OptiC Glyndwr Ltd. (United Kingdom)
Electronic speckle pattern interferometric testing of JWST primary mirror segment assembly [8126-22]
K. Z. Smith, D. M. Chaney, Ball Aerospace & Technologies Corp. (United States); B. N. Saif, NASA Goddard Space Flight Ctr. (United States)

Cryogenic optical testing results of JWST aspheric test plate lens [8126-23]
K. Z. Smith, T. C. Towell, Ball Aerospace & Technologies Corp. (United States)

The optical metrology system for cryogenic testing of the JWST primary mirror segments [8126-25]
J. B. Hadaway, The Univ. of Alabama in Huntsville (United States); D. M. Chaney, L. B. Carey, Ball Aerospace & Technologies Corp. (United States)

The design of MTF test system based on point light source [8126-24]
R. Fu, N. Wu, X. Zhang, Y. Qiu, B. Chang, Nanjing Univ. of Science & Technology (China)

Nanometer profile measurement of large aspheric optical surface by scanning deflectometry with rotatable devices [8126-26]
M. Xiao, S. Jujo, S. Takahashi, K. Takamasu, The Univ. of Tokyo (Japan)

A complete qualification methodology for coatings of precision glass molding tools [8126-20]
F. Klocke, K. Georgiadis, Fraunhofer Institute for Production Technology (Germany) and Fraunhofer Project Ctr. for Coatings in Manufacturing (Germany); O. Dambon, Fraunhofer Institute for Production Technology (Germany); K.-D. Bouzakis, S. Gerardis, G. Skordaris, Fraunhofer Project Ctr. for Coatings in Manufacturing (Germany) and Aristotle Univ. of Thessaloniki (Greece)

Fluid jet and bonnet polishing of optical moulds for application from visible to x-ray [8126-53]
A. T. H. Beaucamp, Zeeko Ltd. (United Kingdom) and Chubu Univ. (Japan); R. R. Freeman, Zeeko Ltd. (United Kingdom); A. Matsumoto, Y. Namba, Chubu Univ. (Japan)

From Herschel to Gaia: 3-meter class SiC space optics [8126-30]
M. Bougoin, J. Lavenac, BOOSTEC S.A. (France)

Swing arm optical CMM: self calibration with dual probe shear test [8126-31]
P. Su, Y. Wang, C. J. Oh, R. E. Parks, J. H. Burge, College of Optical Sciences, The Univ. of Arizona (United States)

Determining parametric TIS behavior from optical fabrication metrology data [8126-32]
J. E. Harvey, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States); S. Shröder, Fraunhofer Institute for Applied Optics and Precision Engineering (Germany); N. Choi, CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States); A. Duparré, Fraunhofer Institute for Applied Optics and Precision Engineering (Germany)
8126 0Y  Extended vertical range roughness measurements in non-ideal environments [8126-33]
K. Creath, 4D Technology Corp. (United States), Optineering (United States), and College of
Optical Sciences, The Univ. of Arizona (United States)

8126 10  Instantaneous measurement Fizeau interferometer with high spatial resolution [8126-35]
D. M. Sykora, P. de Groot, Zygo Corporation (United States)

SESSION 8  MANUFACTURING III

8126 11  Study of air-driving fluid jet polishing [8126-36]
Z.-R. Yu, C.-H. Kuo, C.-C. Chen, W.-Y. Hsu, Instrument Technology Research Ctr. (Taiwan);
D.-P. Tsai, Instrument Technology Research Ctr. (Taiwan) and National Taiwan Univ. (Taiwan)

8126 12  Optical bonding reinforced by femtosecond laser welding [8126-37]
F. Lacroix, Institut Franco-Allemand de Recherches de Saint-Louis (France); D. Hélie,
R. Vallée, COPL, Univ. Laval (Canada)

8126 13  Incorporating VIBE into the precision optics manufacturing process [8126-38]
J. DeGroote Nelson, A. Gould, C. Klinger, M. Mandina, Optimax Systems, Inc. (United States)

8126 14  Computer-aided manufacturing for freeform optical elements by ultraprecision
micromilling [8126-39]
S. Stoebeinau, R. Kleindienst, M. Hofmann, S. Sinzinger, Technische Univ. Ilmenau (Germany)

8126 15  Calibration and optimization of computer-controlled optical surfacing for large optics
[8126-40]
D. W. Kim, College of Optical Sciences, The Univ. of Arizona (United States); H. M. Martin,
Steward Observatory, The Univ. of Arizona (United States); J. H. Burge, College of Optical
Sciences, The Univ. of Arizona (United States) and Steward Observatory, The Univ. of Arizona
(United States)

8126 16  Centration of optical elements [8126-41]
E. Milby, J. Burge, College of Optical Sciences, The Univ. of Arizona (United States)

POSTER SESSION

8126 17  Slow tool servo diamond turning of optical freeform surface for astigmatic contact lens
[8126-28]
C.-C. Chen, Instrument Technology Research Ctr. (Taiwan); Y.-C. Cheng, Instrument
Technology Research Ctr. (Taiwan) and National Tsing Hua Univ. (Taiwan); W.-Y. Hsu,
H.-Y. Chou, Instrument Technology Research Ctr. (Taiwan); P. J. Wang, National Tsing Hua
Univ. (Taiwan); D. P. Tsai, Instrument Technology Research Ctr. (Taiwan) and National Taiwan
Univ. (Taiwan)

8126 18  The fabrication of high filling factor double side micro lens array with high alignment
accuracy [8126-29]
Y.-C. Cheng, Instrument Technology Research Ctr. (Taiwan) and National Tsing Hua Univ.
(Taiwan); C.-C. Chen, W.-Y. Hsu, Instrument Technology Research Ctr. (Taiwan); P. J. Wang,
National Tsing Hua Univ. (Taiwan); D. P. Tsai, Instrument Technology Research Ctr. (Taiwan)
and National Taiwan Univ. (Taiwan)
8126 19 Mirror segments for large mirror systems of weak optical signals detectors for UV spectral range [8126-42]
P. Schovanek, M. Hrabovsky, M. Palatka, M. Pech, D. Mandat, L. Nozka, A. Dejneka, Institute of Physics of the ASCR, v.v.i. (Czech Republic); J. Jankuj, Meopta - optika, s.r.o. (Czech Republic); M. Vujtek, Palacky Univ. Olomouc (Czech Republic)

8126 1A Manufacturing process optimization of phase plates for depth extension microscopy systems [8126-43]

8126 1B An intuitive concept for manufacturing and inspecting of aspherical components [8126-44]
H.-Y. Chou, Instrument Technology Research Ctr. (Taiwan) and Chung Hua Univ. (Taiwan); K.-S. Chang, Instrument Technology Research Ctr. (Taiwan)

8126 1C Verification program for a high-precision large cryogenic lens holder [8126-45]
A. Boesz, Kayser-Threde GmbH (Germany); F. Grupp, Max-Planck-Institut für extraterrestrische Physik (Germany) and Univ.-Sternwarte München (Germany); T. Leberle, A. Motlaghibonob, Kayser-Threde GmbH (Germany); N. Geis, Max-Planck-Institut für extraterrestrische Physik (Germany); R. Bender, Max-Planck-Institut für extraterrestrische Physik (Germany) and Univ.-Sternwarte München (Germany)

8126 1D Flexible manufacturing of large aspheres for VLT's Optical Tube Assemblies [8126-46]
G. Gubbels, R. Henselmans, C. van Drunen, TNO (Netherlands)

8126 1E New approach for pre-polish grinding with low subsurface damage [8126-47]
J. B. Johnson, D. W. Kim, R. E. Parks, J. H. Burge, College of Optical Sciences, The Univ. of Arizona (United States)

8126 1F Optical contacting of low-expansion materials [8126-48]
G. Kalkowski, S. Risse, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); C. Rothhardt, Friedrich Schiller Univ. (Germany); M. Rohde, R. Eberhardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany)

8126 1G Package technology for microcavities [8126-49]
W.-D. Zhang, Y.-Z. Yan, J. Liu, S.-B. Yan, C.-Y. Xue, J.-J. Xiong, North Univ. of China (China)

8126 1H The photoanisotropy in the holographic media on the basis of silver halide emulsion [8126-50]
V. Shaverdova, S. Petrova, A. Pursseladze, L. Tarasashvili, Georgian Technical Univ. (Georgia)

8126 1I Development of high-performance, stable, and moisture-resistant polarization-sensitive materials [8126-51]
I. Chaganava, G. Kakauridze, B. Kliosanidze, G. Datukishvili, Institute of Cybernetics (Georgia)

Author Index