

# **2nd EOS Conference on Manufacturing of Optical Components 2011**

**(EOSMOC 2011)**

**Munich, Germany  
23-25 May 2011**

**ISBN: 978-1-61839-607-5**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2011) by the European Optical Society  
All rights reserved.

Printed by Curran Associates, Inc. (2012)

For permission requests, please contact the European Optical Society  
at the address below.

European Optical Society  
c/o Laser Zentrum Hannover  
Hollerithallee 8  
30419 Hannover Germany

Phone: +49-511-2788-115  
Fax: +49-511-2788-119

[www.myeos.org/about](http://www.myeos.org/about)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## SUB-CONFERENCE: THEORETICAL AND PRACTICAL ASPECTS OF MANUFACTURING AND FINISHING TECHNOLOGIES

### SURFACE FINISHING ASPECTS

<b>Deterministic Fabrication Process For Precision X-Ray Mirrors</b> .....	1
<i>K. Yamauchi</i>	
<b>Ion Beam Figuring Of Crystalline Optical Materials</b> .....	3
<i>Marcel Demmler, Michael Zeuner, Alfonz Luca, Thoralf Dunger, Dirk Rost, Sven Kiontke, Marcus Kruger</i>	
<b>Improved Ion Beam Figuring Technology Using Motion Synchronized Pulse Width Modulated Ion Beam Control</b> .....	5
<i>F. Pietag, A. Nickel, T. Hansel, K. Nomura, A. Schindler</i>	

### ASPHERE AND FREEFORM ASPECTS

<b>Precision Machining Of Optical Surfaces With Small Plasma Jet Tools</b> .....	8
<i>Thomas Arnold, H. Paetzelt, G. Bohm, M. Janietz, I. M. Eichentopf</i>	
<b>High-Rate Plasma Jet Machining for the Aspherization of Fused Silica Optics</b> .....	10
<i>G. Bohm, T. Arnold, H. Paetzelt, A. Schindler</i>	
<b>A Closed Look On Essential Parts Of The Polishing System In Chemo-Mechanical Polishing</b> .....	12
<i>F. Klocke, D. Waechter, U. Schneider, O. Dambon</i>	
<b>Fast Design of Freeform Optics</b> .....	14
<i>R. Fessler, J. Jegorovs, N. Siedow, R. Wegener</i>	

### DIAMOND MACHINING AND STRUCTURING ASPECTS

<b>Diamond Machining of Retroreflective Cube Corner Arrays</b> .....	16
<i>E. Brinksmeier, R. Glabe, L. Schonemann</i>	
<b>Setpoint Generation Strategies for Freeform Machining</b> .....	18
<i>C. Brecher, C. Buss, C. Wenzel, D. Lindemann</i>	
<b>Diamond Turning Of Meltspun Aluminium For Visual Optical Applications</b> .....	20
<i>Guido Gubbels, Roger Senden, Xuwen Liu</i>	
<b>Expanding The Applicability Domain Of Phase-Mask Lithography Of Gratings To The Extreme</b> .....	22
<i>Y. Bourgin, Y. Jourlin, S. Tonchev, I. Vartiainen, O. Parriaux, M. Kuittinen, A. Talneau</i>	

## SUB-CONFERENCE: OPTICS MANUFACTURING PROCESSES

### MORNING SESSION

<b>Adjustment Turning of Inorganic-Metallic Mounted Optical Components</b> .....	24
<i>R. Eberhardt, E. Beckert, A. Gebhardt, C. Bruchmann, Th. Burkhardt, A. Tunnermann</i>	
<b>Fully Automated Assembly of Micro Lenses for High Power Diode Lasers</b> .....	26
<i>H. Schroder, S. Marx, J. Meinschien, A. Timmermann, D. Goldberg, T. Vahrenkamp, A. Weber, B. Neumann, S. Wright, T. Westphalen</i>	
<b>Wide Phase-Mask Printing Of Large Area Gratings With Proportionate Investment Costs</b> .....	28
<i>Y. Bourgin, Y. Jourlin, P. Muller, B. Kress, T. Kampfe, I. Vartiainen, M. Kuittinen, O. Parriaux, B. Kley</i>	
<b>UV-Cured Glassy Material For The Manufacture Of Bulk And Nanostructured Elements</b> .....	30
<i>Raz Gvishi, Galit Sturm, Abraham Englander</i>	

## NOON SESSION

<b>Dispensing and Printing of Polymer Optical Waveguides</b> .....	32
<i>Michael Dumke, Ralf Rieske, Daniel Craiovan, Ludger Overmeyer</i>	
<b>Rapid Prototyping Of Diffractive Optical Elements In Microstructured Sol-Gel Hybrid Material</b> .....	34
<i>A. Chan Yong, K. Heggarty, C. Carre, D. Battarel</i>	
<b>Precise Processing Of Transparent Dielectrics By Pulsed Laser Radiation</b> .....	37
<i>K. Zimmer, R. Bohme, M. Ehrhardt, P. Lorenz</i>	
<b>Fast 3D Figuring of Large Optical Surfaces Using Reactive Atom Plasma (RAP) Processing</b> .....	39
<i>R. Jourdain, M. Castelli, P. Morantz, P. Shore</i>	

## AFTERNOON SESSION

<b>Removal of Mid Spatial-Frequency Features in Mirror Segments</b> .....	41
<i>G. Yu, H. Li, D. Walker</i>	
<b>Diamond Turning Of Freeform Telescope Mirrors For TROPOMI</b> .....	43
<i>Guido Gubbels, Rens Henselmans, Bart Van Venrooy, Peter Van Doorn</i>	
<b>Laser Polishing Of Spherical Quartz Lenses</b> .....	45
<i>A. Richmann, E. Willenborg, K. Wissenbach</i>	
<b>Mould Fabrication For Polymer Optics</b> .....	47
<i>M. Speich, R. Borret</i>	
<b>Dwell Time Assisted Grinding</b> .....	49
<i>C. Vogt, H. Adelsberger, R. Maurer, F. Schneider, T. Koller, S. Draxinger, S. Sinzinger, R. Rascher, P. Sperber</i>	

## POSTER SESSION

### SUB-CONFERENCE: OPTICAL MANUFACTURING FOR EMERGING PRODUCTS AND PROCESSES

<b>High Concentration Photovoltaics: Design And Manufacturing Challenges</b> .....	51
<i>Juan C. Minano, Pablo Benitez, Pablo Zamora</i>	
<b>E-ELT Optics Production: Challenges &amp; Results On Proto Demonstration</b> .....	55
<i>Roland Geyl</i>	
<b>Wafer Level Manufacturing of Glass Optics</b> .....	56
<i>F. Klocke, O. Dambon, D. Hollstegge, H. Hunten</i>	
<b>Grating Phase-Mask Lithography For Subwavelength Radial Polarizer Fabrication</b> .....	58
<i>Y. Jourlin, C. Veillas, S. Tonchev, J. Sauvage-Vincent, U. Zeitner, O. Parriaux</i>	
<b>MEMS Based Dual-Axis Confocal Fluorescence Handheld Microscope</b> .....	60
<i>W. Piyawattanametha, M. J. Mandella</i>	

### SUB-CONFERENCE: EUROPEAN SUPPORT INSTRUMENTS FOR OPTICAL COMPONENTS MANUFACTURERS

<b>Photonics in the EU: Opportunities and Challenges</b> .....	62
<i>Ronan Burgess</i>	
<b>EUMINAFAB - A European Research Infrastructure For Micro-Nano Fabrication Of Functional Structures And Devices</b> .....	63
<i>Jurgen Mohr</i>	
<b>ACTMOST: Supporting Companies With “Photonics Technology Services” Instead Of “Money”</b> .....	64
<i>Hugo Thienpont, Malgorzata Kujawinska, Juergen Mohr</i>	

### SUB-CONFERENCE: TESTING FOR FABRICATION AND ASSEMBLY

#### MEASUREMENT OF OPTICAL COMPONENTS AND SYSTEMS I

<b>Diffractive Simultaneous Lateral Shearing Interferometry</b> .....	65
<i>V. Nercissian, I. Harder, K. Mantel, A. Berger, N. Lindlein</i>	

<b>Aspherical Surface Measurement using Quadri-Wave Lateral Shearing Interferometry</b> .....	67
<i>William Boucher, Pascal Delage, Benoit Wattellier</i>	
<b>Advances Studies On The Measurement Of Aspheres And Freeform Surfaces With The Tilted-Wave Interferometer</b> .....	69
<i>Eugenio Garbusi, Goran Baer, Wolfgang Osten</i>	

## **MEASUREMENT OF OPTICAL COMPONENTS AND SYSTEMS II**

<b>Some Challenges In Shape Measurement Of Optical Freeform Surfaces</b> .....	71
<i>Gunther Notni</i>	
<b>3D-Profilometry On Aspheric And Freeform Lenses</b> .....	73
<i>Andreas Beutler</i>	
<b>Measurements Of Aberrations Of Aspherical Lenses Using Experimental Ray Tracing</b> .....	75
<i>Ufuk Ceyhan, Thomas Henning, Friedrich Fleischmann, David Hilbig, Dietmar Knipp</i>	
<b>Automated Alignment Of Aspheric And Freeform Surfaces In Non-Null Test Interferometry</b> .....	77
<i>Goran Baer, Eugenio Garbusi, Wolfram Lyda, Wolfgang Osten</i>	
<b>Measuring Amplitude And Phase Of Light Emerging From Microstructures With HRIM</b> .....	79
<i>Myun-Sik Kim, Toralf Scharf, Hans Peter Herzig</i>	

## **THEORETICAL AND PRACTICAL ASPECTS OF MANUFACTURING AND FINISHING TECHNOLOGIES**

<b>The Dependence Of The 1st Order Diffraction Efficiency On The Structures Of Binary Diffractive Lens With The 100 <math>\mu\text{m}</math>-Order-Focal Lengths On A PET Film</b> .....	81
<i>A. Motogaito, K. Arakawa, H. Miyake, K. Hiramatsu</i>	
<b>Fabrication And Characterization Of The Binary Diffractive Concave Lens With 2 Mm-Focal-Length On A Cyclic Olefin Polymer Film</b> .....	83
<i>A. Motogaito, Y. Seriguchi, H. Miyake, K. Hiramatsu, H. Yoshino</i>	
<b>Analytical Solution For The Distribution Of Scattering Elements In Edge-Lit Backlight Units</b> .....	85
<i>Mihai Kusko, Cristian Kusko, Dana Cristea</i>	
<b>Direct Laser Fabrication Of Blaze Gratings In Fused Silica</b> .....	87
<i>M. Pfeifer, S. Weissmantel, G. Reisse</i>	
<b>Data Handling in Modern Optics Manufacturing Processes</b> .....	89
<i>T. Bobek, C. Zymła, L. Glasmacher</i>	
<b>Correction of Sub-Millimeter Spatial Wavelength Polishing Errors by Atmospheric Plasma Jet Machining</b> .....	91
<i>Hendrik Paetzelt, G. Bohm, Th. Arnold, M. Weiser, N. Kaier, A. Schindler</i>	
<b>Replica Molding of Optical Components in Polymers</b> .....	93
<i>P. Obreja, A. Dinescu, M. Kusko, A. C. Obreja, D. Cristea</i>	
<b>Rehabilitation Of Wet Etching For The Low-Cost Manufacturing Of Highly Selective Subwavelength Gratings Of High Efficiency</b> .....	95
<i>S. Tonchev, Th. Kampfe, O. Parriaux</i>	
<b>Holistic Fabrication Of Stitchingless Subwavelength Cylindrical Gratings By Phase-Mask Coordinate Transform</b> .....	97
<i>S. Tonchev, N. Lyndin, Y. Jourlin, F. Celle, O. Parriaux, K. Kuittinen, J. Laukkanen</i>	

## **SUB-CONFERENCE: OPTICS MANUFACTURING PROCESSES**

<b>Double-Sided Exposure For Large Blaze-Angle Saw-Tooth Grating Manufacturing</b> .....	99
<i>S. Tonchev</i>	
<b>Specific Exposure And Photochemistry On Dissolvable 3D-PMMA Microoptical Masters With Resist Surface Grating</b> .....	101
<i>S. Tonchev, O. Parriaux, M. Wissmann, Guttmann, J. Mohr, J. Krezel, M. Kujawinska</i>	
<b>Freeform Correction For Molding High Precision Plane Optical Surfaces</b> .....	103
<i>Lars Dick</i>	
<b>Differentiation Of Influences In Deterministic Polishing</b> .....	105
<i>Andreas Kelm, Rainer Boerret, Stefan Sinzinger</i>	
<b>Modelling And Measurement Of Polishing Tool Influence Functions For Edge Control</b> .....	107
<i>H. Li, R. Evans, G. Yu, D. Walker</i>	

<b>Design And Fabrication 1-D Electrostatically Actuated Torsional MEMS Micro-Mirror Based On SU-8</b> .....	109
<i>M. Khalafi, H. Latifi, M. Ghaderi, I. Sabri, A. Moazenzadeh</i>	
<b>Laser-Induced Front Side And Back Side Etching Of Fused Silica With KrF And XeF Excimer Lasers Using Metallic Absorber Layers: A Comparison</b> .....	111
<i>Pierre Lorenz, Martin Ehrhardt, Klaus Zimmer</i>	
<b>Investigation of CAD/CAM Supported Freeform Grinding on State-of-the-Art 5-Axis Optic Machine Centers</b> .....	113
<i>Jens Bliedner, Michael Wagner, Christian Schindler</i>	
<b>3D Electron Beam Lithography In For <math>\mu</math>- And N-Optics</b> .....	115
<i>Dana Cristea, Adrian Dinescu, Paula Obreja, Roxana Rebigan</i>	
<b>3 - Meter Class Space Optics Made Of SiC</b> .....	117
<i>M. Bougoin, J. Lavenac</i>	
<b>Key Manufacturing Technology Of Optical Components For EUV Experimental Lithographer</b> .....	119
<i>O. B. Danilov, A. P. Zhevlakov</i>	
<b>Rapid Grinding of Metre-Scale Hexagonal Mirror Segments for Ground Based Telescopes</b> .....	121
<i>P. Comley, P. Morantz, P. Shore, X. Tonnellier</i>	

### **SUB-CONFERENCE: OPTICAL MANUFACTURING FOR EMERGING PRODUCTS AND PROCESSES**

<b>A Novel Diffraction Type Splitter Applied On Autostereoscopic Display</b> .....	122
<i>Chien-Yue Chen, Hui-Hsiung Lin, Bor-Shyh Lin, Shi-Chang Tseng, Qing-Long Deng</i>	
<b>Monolithic Optical Component With Segmented Free Form Micro Optics</b> .....	124
<i>M. Jarczyński, I. Steiner, T. Mitra, L. Aschke</i>	
<b>Emission Spectrum And Color Of Sulfur Lamp Which Is Maintained By Microwaves</b> .....	126
<i>Yu. P. Machekhin, T. I. Frolova, I. A. Shunkova</i>	
<b>High Aspect Ratio Iridium Wire Grid Polarizer For UV Applications</b> .....	128
<i>T. Weber, T. Kasebier, A. Szeghalmi, M. Knez, E. B. Kley, A. Tunnermann</i>	
<b>Applicative Trends For Microstructured Optics At Carl Zeiss</b> .....	130
<i>H. Helgert, R. Steiner, M. Burkhardt, T. Glaser, A. Pesch, O. Sandfuchs, L. Erdmann, A. Deparnay, M. Cumme, A. Gatto</i>	

### **SUB-CONFERENCE: TESTING FOR FABRICATION AND ASSEMBLY**

<b>The Effect of the Surface State on the Strength of Optical Glass and Glassceramics</b> .....	132
<i>V. P. Maslov</i>	
<b>Development And Verification Of A Wafer Adjustment Process Via Wavefront-Analysis</b> .....	133
<i>R. Schmitt, R. Krappig</i>	
<b>Fast Contact-Free Metrology Based On Multiwavelength Interferometry</b> .....	135
<i>G. Berger, J. Petter, R. Nicolaus</i>	
<b>Non-Contact Measurement Of Aspherical And Free-Form Optics With A New Confocal Tracking Profiler</b> .....	137
<i>A. Pinto, C. Cadevall, R. Artigas, F. Laguarda</i>	
<b>Nanostructural Image Modelling For Testing Of EUV Projective Objective</b> .....	139
<i>A. P. Zhevlakov, O. B. Danilov, E. V. Gavrilov</i>	
<b>Author Index</b>	