AOMATT 2016

The 8th SPIE International Symposium on

Advanced Optical Manufacturing and Testing Technologies

26-29 April 2016
Suzhou International Conference Center
Suzhou China

Sponsored by:

COS - The Chinese Optical Society
IOE - Institute of Optics and Electronics,
- Chinese Academy of Sciences
SPIE - The International Society for Optics and Photonics
- (*Technical Co-Sponsor*)

Supported by:

Ministry of Science and Technology of China
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Honorary Chair:

Guangcan GUO, President of Chinese Optical Society (COS), Academician, Chinese Academy of Sciences

Symposium General Chair:

Liwei ZHOU, President of Beijing Optical Society (BOS), Academician, Chinese Academy of Engineering, Beijing Institute of Technology

Conferences:

1 Large Mirror and Telescopes ····· [SPIE Proceeding Vol. 9682]
2 Advanced Optical Manufacturing Technologies [SPIE Proceeding Vol. 9683]
3 Optical Test, Measurement Technology, and Equipment ····· [SPIE Proceeding Vol. 9684]
4 Design, Manufacturing and Testing of Micro and Nano Optical Devices and Systems ····· [SPIE Proceeding Vol. 9685]
5 Opto-Electronics Material and Devices for Sensing and Imaging ····· [SPIE Proceeding Vol. 9686]
6 Smart Structure and Materials in Advanced Optical Technology ····· [SPIE Proceeding Vol. 9687]
7 Sub-nanometer Accuracy Measurement for Synchrotron Optics and X-ray Optics ····· [SPIE Proceeding Vol. 9688]
WORKSHOP-Innovation in Emerging Photon Industry

Contents

AOMATT China 2016 Organizing Committee • Tel/Fax +86 028 85100583
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Organizations & Committees

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COS - The Chinese Optical Society

中国光学学会
The Chinese Optical Society

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中国科学院光电技术研究所
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SPIE.
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Symposium General Co-Chairs:

Jianlin CAO, Vice Minister of China Ministry of Science and Technology
David R. Silva, Director of the National Optical Astronomy Observatory (NOAO)
Eric Mazur, Professor of Physics and Applied Physics at Harvard University, Dean of Applied Physics, USA
H. Philip Stahl, SPIE President 2014, USA
Yinnan YUAN, Vice President of Soochow University
Yudong ZHANG, President of Chengdu Branch, Chinese Academy of Sciences, Director of Academic Committee of Institute of Optics and Electronics

Local Supporting Organizer:

- Soochow University

Supporting Organization:

- National University of Defense Technology
- University of Electronic Science and Technology of China

- Sichuan University
- State Key Laboratory of Optical Technologies for Nano-Fabrication and Micro-Engineering
- Key Laboratory of Adaptive Optics, Chinese Academy of Sciences
- Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP)
- University of Shanghai for Science and Technology (USST)
- Beijing Institute of Technology
- Changchun University of Science and Technology
- Nanjing University of Science and Technology
- The Hong Kong Polytechnic University
- Zhejiang Quartz Crystal Optoelectronic Technology Co., LTD
- Suzhou Association for Sciences and Technology
- Optical society of Sichuan Province

Managed by:

- Committee of Optical Manufacturing Technology (COMT), COS (China)

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Liangchi ZHANG, Professorial Fellow of Australian, University of New South Wales Australia
Ralf D. Geckeler, Head of the Length and Angle Graduations Group, Physikalisch-Technische Bundesanstalt, Germany
Oltmann Riemer, Head of the Laboratory for Precision Machining co-ordinating and administrating the entire R&D work of LFM

Organizing Committee:

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Shinan QIAN, Brookhaven National Laboratory (USA)
Myung K. Cho, NOAO (USA)

Program Committee:

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Yuwen QIN, Director of Information Department, National Natural Science Foundation of China (Co-chair)
Jingchi YU, Professor of Soochow University (Co-chair)

Symposium General Secretary:

Li YANG, Committee of Optical Manufacturing Technology (COMT), COS (China)
Jinxue WANG, SPIE (USA)

Symposium Honorary Chair:

Guangcan GUO, President of Chinese Optical Society (COS), Academician, Chinese Academy of Sciences

Professor Guo Guangcan, Member of CAS, Chief Scientist of 973 Project, currently teaching at University of Science and Technology of China, signed with NUPT on October 31st to become an honorary professor with the university. President Yang Zhen attended the ceremony to present the letter of appointment, after which Professor Guo gave a lecture titled "Quantum High Precision Measurement based on Weak Measurement Theory", and had a follow-up discussion with the audience.

Guo Guangcan, professor with University of Science and Technology of China, and Director of the Key Lab of CAS Quantum Information, is Chief Scientist in his field in Chinese Academy of Sciences, and Chief Scientist of Quantum Communication and Quantum Communication Technologies.

Professor Guo has long devoted himself to the research on theory and experiment of quantum optics, quantum cryptography, quantum communication, and quantum computation, as well as the teaching of Optics and Physics, and has achieved a series of internationally recognized accomplishments. He has published over 820 journal researches, with SCI 10781 citations, including 9788 non-self citations, and 11 book-length researches (translations). He has supervised a total of 40 PHD candidates and 30 Master candidates, 4 of whom have made the Top Hundred PHD Dissertations and 2 recipients of National Outstanding Youth Fund. Professor Guo has been awarded the honor of Progressive Staff of CAS, MoE Outstanding Teachers of China, and was elected Member of CAS in 2003.

Symposium General Chair:

Liwei ZHOU, President of Beijing Optical Society, Academician, CAE

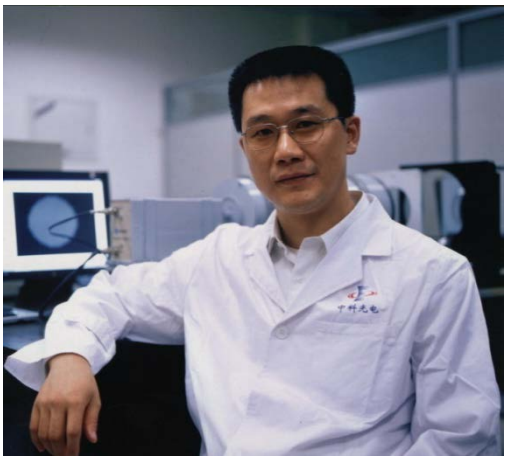
Liwei ZHOU, Professor, Ph.D, Member of Chinese Academy of Engineering, was born in Shanghai in 1932. He was graduated from Beijing Institute of Technology (BIT) in 1958 and received the USSR Candidate Degree (Ph.D) of physics-mathematical science in 1966. In 1984 he was titled "Outstanding Expert at the State Level" for developing a school of his own in the electron optics study, and in the same year he was promoted to the rank of full professor. He used to be the Chairman of Academic Committee, BIT, the vice president of Chinese Optical Society and Chairman of Association of Science and Technology, BIT. Now he is the Chair-Expert of BIT, Honorary Director of School of Basic Education of BIT and president of Beijing Optical Society.

Prof. Zhou Liwei is engaged in electron optics and photoelectronic imaging. Since 1978, Prof. Zhou Liwei has published 6 monographs and 6 printed teaching materials and more 270 academic and technical papers at home and abroad. His monograph "Electron Optics with Wide Beam Focusing" has been awarded the Chinese Books Prize in 1994, the National Books Prize (nominative prize) in 1995 and the Nation-wide Scientific Excellent Books First Prize in 1995.

Achievements of Prof. Zhou Liwei in scientific research were awarded the National Science Congress Prize in 1978, the Ministry 's First and Second Prizes for Science and Technology Progress in 1980, 1990, 1995 and 1996, the Guang Hua Fund First Prize for Science and Technology in 1991. He was also twice of the winner of State Prize for Science and Technology Progress in1991 and 1996. In 1996 , he was given a title of "Advanced Worker" by State Personnel Ministry for his outstanding service in educational and scientific field. In 1997, he got an Honorary Degree of Doctor of Science by Samara State Aerospace University, Russia. In 1999, he was elected member of Chinese Academy of Sciences, and in 2000, he was elected Foreign member of Academy of Engineering Sciences of the Russian Federation.

Organization Committee:

Yudong, **ZHANG** President of Chengdu Branch, Chinese Academy of Sciences (China)



Yudong ZHANG, PhD and Research Professor, President of Chengdu Branch, CAS (Chinese Academy of Sciences) is a member of the Appraisal Expert Team of Information Directorate of NSFC (National Natural Science Foundation of China), a vice-chair of Bio-optics and Laser Medicine Subcommittee of COS (Chinese Optical Society), a vice-Chair of Electro-Optical Specialty Committee of Chinese Society of Astronautics, and a committeeman of Quantum Electronics and Electro-Optical Subcommittee of CIE (Chinese Institute of Electronics), an adjunct professor of UESTC (University of Electronic Science and Technology of China) and Zhejiang University respectively.

Mr. Zhang received his BS from Zhejiang University in 1984, his MS from IOE in 1987, and his PhD from Shanghai Institute of Optics and Fine Mechanics, CAS, in 1991. From 1991 to 1997 he held the technical posts of Research Assistant, Research Associate Professor and Research Professor in Fujian Institute of Research on the Structure of Matter, CAS. He has been working in IOE since 1998 and serving as President since 2003.

For more than 10 years, he has carried out many frontier researches in the fields of adaptive optics, microlithography and new materials of non-linear optics and has obtained many innovative achievements which are leading in China or advanced in the world. He has won one first-grade award of CAS Prize for S&T Progress and CAS Prize for Invention respectively. Altogether, he has applied for and obtained 38 pieces of patents, and published more than 50 papers among which 30 are included in EI Database and 10 in SCI Database.

From1998 to present, he has been taking charge of the development of the adaptive optical (AO) system for imaging live human eye retina with high resolution. The system is the first practical compact AO system for this application in the world.

He is also in charge of the development of Dynamic Wavefront Correction AO System for the new generation of ICF prototype system in China. It is the first AO system which can reduce the wavefront distortion of laser beam in ICF system from 9λ to about 1.5λ in China. This extends the application of adaptive optics in the ICF field and is at the advanced world level.

Organization Committee:

Enhai LIU, Vice President of Institute of Optics and Electronics, CAS (China)

Professor LIU Enhai, Vice President of Institute of Optics and Electronics (IOE) Chinese Academy of Sciences, graduated from Dalian University of Technology in 1987, and received his master degree in University of Electronic Science and Technology of China in 2004. He is a committee member of Chinese Optical Society, Chinese Optical Engineering, and Space Optical Engineering.

Professor LIU engaged in space optical precision measurement technology, especially in light-weight and compact design of the space system, high-sensitivity, low-noise signal processing, real-time image extraction and recognition, smart visual servo method, high dynamic performance control systems, high-precision imaging testing and calibration technology.

As a project leader, chief designer and engineer, professor LIU completed many important projects from national 863, 973, manned space flight and lunar exploration project

He has published over 20 papers and trained more than 20 doctors and masters.

Daily Event Schedule

Date	Time	Contents	Location
Friday April 25, 2016	8:00-20:00	Registration for domestic authors	Lobby of Suzhou International Conference Center(苏州国际会议中心一楼 大堂)
	8:00-20:00	Registration for overseas authors	Lobby of Suzhou International Conference Center(苏州国际会议中心一楼 大堂)
	After 20:00	Contact US	
Saturday April 26, 2016	8:30-9:00	Opening Ceremony	GREAT HALL OF THE PEOPLE, Suzhou International Conference Center(苏州国际会议中心 **3 号楼 大会堂**) BUILDING 3
	9:00-12:30	Plenary Presentation 1 to 4	
	13:30-17:00	Plenary Presentation 5 to 8	
	18:30-20:30	Buffet Reception (自助欢迎招待会)---FENGLEGONG BUILDING 8(8 号楼 3 楼)	
Sunday April 27, 2016	8:30-12:00	Session 1-1	FENGLE HALL, floor 2 (2 楼 丰乐厅) — BUILDING 8 (8 号楼)
		Session 2-1	LONGFENG HALL, floor 3 (3 楼 龙凤厅) — BUILDING 8 (8 号楼)
		Session 3-1	HEHE HALL, floor 3 (3 楼 和合厅) — BUILDING 8 (8 号楼)
		Session 4-1	Multi-fuctional HALL, floor 1 (1 楼 多功能厅) — BUILDING 3 (3 号楼)
		Session 5-1	FULE HALL, floor 3 (3 楼 福乐厅) — BUILDING 8 (8 号楼)
		Session 6-1	PINGJIANG HALL, floor 4 (4 楼 平江厅) — BUILDING 3 (3 号楼)
		Session 7-1	SHUANGXI HALL, floor 4 (3 楼 双喜厅) — BUILDING 8 (8 号楼)
	13:00-17:00	Session 1-1	FENGLE HALL, floor 2 (2 楼 丰乐厅) — BUILDING 8 (8 号楼)
		Session 2-1	LONGFENG HALL, floor 3 (3 楼 龙凤厅) — BUILDING 8 (8 号楼)
		Session 3-1	HEHE HALL, floor 3 (3 楼 和合厅) — BUILDING 8 (8 号楼)
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		Session 5-1	FULE HALL, floor 3 (3 楼 福乐厅) — BUILDING 8 (8 号楼)
		Session 7-1	SHUANGXI HALL, floor 3 (3 楼 双喜厅) — BUILDING 8 (8 号楼)
	19:30-21:00	Welcome Party(中外嘉宾联欢晚会)	GREAT HALL OF THE PEOPLE (苏州国际会议中心 **3 号楼 大会堂**)
Monday April 28, 2016	8:30-12:00	Session 2-3	LONGFENG HALL, floor 3 (3 楼 龙凤厅) — BUILDING 8 (8 号楼)
		Session 3-3	HEHE HALL, floor 3 (3 楼 和合厅) — BUILDING 8 (8 号楼)
		Session 7-3	SHUANGXI HALL, floor 3 (3 楼 双喜厅) — BUILDING 8 (8 号楼)
		Workshop Foreign manufacturers technical seminar(国外厂商技术讲座)	FULE HALL of BUILDING 8 (苏州国际会议中心 **8 号楼 3 楼** 福乐厅)
	13:00-17:00	Poster Presentations	EXHIBITION HALL of BUILDING 8 (苏州国际会议中心 **8 号楼 1 楼 展示厅**)

Opening Ceremony

8:30-9:00 April 26, 2016 Opening Ceremony

Location: GREAT HALL, Suzhou International Conference Center

Chair: YANG Li, Committee of Optical Manufacturing Technology, COS
WANG Jinxue, SPIE, USA

Plenary Presentation

9:00-12:00 April 26 Plenaries 1 to 4 GREAT HALL

Location: GREAT HALL, Suzhou International Conference Center

Plenary Session 1

Chair: Wenhan JIANG, Academician, IOE, CAS

(Time: 9:00 to 9:45)

1. **Less is More: Extreme Optics with Zero Refractive Index(少即多：零折射率极端光学)**

Dr. Eric Mazur

Harvard University(哈佛大学应用物理学院教授，院长)

Balkanski Professor of Physics and Applied Physics at Harvard University and Area Dean of Applied Physics

(Time: 9:45 to 10:30)

2. **Large Optical Telescopes in the Era of Large Wide-field Survey(进入大视场纪元的大型天文望远镜)**

Dr. David R. Silva

Director, National Optical Astronomy Observatory (NOAO)

(美国国立光学天文台台长)

Tea time (10:30-11:00)

Plenary Session 2

Chair: Junhua PAN, Academician of Chinese Academy of Engineering

(Time: 11:00 to 11:45)

3. **The European Extremely Large Telescope (E-ELT) Revolution is under construction(欧洲南方天文台极大型天文望远镜—革命在进行中)**

Dr. Marc Cayrel

European Southern Observatory (ESO)

Project Manager, E-ELT Optomechanics (欧南台极大望远镜光机总体项目主任)

(Time: 11:45 to 12:30)

4. Ultra-precision Lens Fabrication via Moulding: Advances and Challenges(超精密透镜模压制造：前瞻和挑战)

Dr. Liangchi ZHANG (章亮炽)

Scientia Professor

Head of Lab for Precision and Nano Processing Technologies, Fellow of Australian Academy of Technological Science and Engineering (澳大利亚工程院院士，澳大利亚新南威尔士大学精密仪器与纳米加工技术实验室主任，新南威尔士大学学科卓越教授)

Lunch time (12:30-13:30)

13:30-17:00 April 26 Plenaries 5 to 8 GREAT HALL

Location: GREAT HALL, Suzhou International Conference Center

Plenary Session 3

Chair: Myung K. Cho, National Optical Astronomy Observatory (USA)

(Time: 13:30 to 14:15)

5. Advancing Ultra Precision Machining to High Performance(高性能先进超精机床技术)

Dr.-Ing. Oltmann Riemer

University of Bremen (德国不来梅大学精密机床实验室主任)

Head of the Laboratory for Precision Machining co-ordinating and administrating the entire R&D work of LFM

(Time: 14:15 to 15:00)

6. Micro/nano Optics for Flexible Functional Devices: Today and Future(微纳光学与柔性电子材料(器件):现状与展望)

Dr. Linsen CHEN (陈林森)

Soochow University

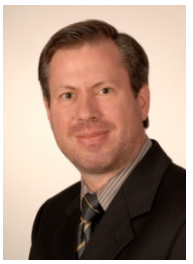
Chief of National United Engineering Research Center of Digital Optical Imaging and Display, and Director of Holography & Optical Information Processing Committee of Chinese Optical Society (数码激光成像显示国家地方联合工程研究中心主任，中国光学学会全息与光信息处理专委会主任)

Tea time (15:00-15:20)

Plenary Session 4

Chair: Yinnan YUAN, Vice President, Soochow University

(Time: 15:20 to 16:05)



7. **New Angles on Angle Metrology: Approaching Fundamental Limits(角度测量的新角度：趋近基本测量极限的新方法)**

Dr. Ralf D. Geckeler

Physikalisch-Technische Bundesanstalt, Germany

Head of Length and Angle Graduations Group (德国联邦物理技术研究院长度暨角度梯度计量室主任)

(Time: 16:05 to 16:50)

8. **Functional Photonic Nanostructures: From Thin Films and Slits to Catenaries(功能性光子学纳米结构：从薄膜、狭缝到链状网)**

Dr. Xiangang LUO (罗先刚)

Vice President of Institute of Optics and Electronics, CAS

Director of State Key Laboratory of Optical Technologies for Nano-Fabrication and Micro-Engineering(中国科学院光电技术研究所副所长，微细加工光学技术国家重点实验室主任)

Workshop Schedule

9:00-12:00 April 28 Workshop FULE HALL of BUILDING 8 (苏州国际会议中心 8 号楼 3 楼 福乐厅)

✓	**OPTurn Company Ltd 北京欧唐科技发展有限公司**	**9:00-10:00**
✓	**法国 SAGEM 公司**	**10:00-11:00**
✓	**奥普泰克亚洲有限公司**	**11:00-12:00**

Poster Schedule

13:00-17:00 April 28 Poster EXHIBITION HALL of BUILDING 8 (苏州国际会议中心 8 号楼 1 楼 展示厅)

9:00-9:45 April 26 ····· Plenary Presentation 1
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 1***

Title: Less is More: Extreme Optics with Zero Refractive Index (少即多：零折射率极端光学)

Dr. Eric Mazur
Harvard University(哈佛大学应用物理学院教授，院长)
Balkanski Professor of Physics and Applied Physics at Harvard University and Area Dean of Applied Physics

Abstract: Nanotechnology has enabled the development of nanostructured composite materials (metamaterials) with exotic optical properties not found in nature. In the most extreme case, we can create materials which support light waves that propagate with infinite phase velocity, corresponding to a refractive index of zero. This zero index can only be achieved by simultaneously controlling the electric and magnetic resonances of the nanostructure. We present an in-plane metamaterial design consisting of silicon pillar arrays, embedded within a polymer matrix and sandwiched between gold layers. Using an integrated nano-scale prism constructed of the proposed material, we demonstrate unambiguously a refractive index of zero in the optical regime. This design serves as a novel on-chip platform to explore the exotic physics of zero-index metamaterials, with applications to super-coupling, integrated quantum optics, and phase matching.

Principal Author's Biography:
Eric Mazur is the Balkanski Professor of Physics and Applied Physics at Harvard University and Area Dean of Applied Physics. An internationally recognized scientist and researcher, he leads a vigorous research program in optical physics and supervises one of the largest research groups in the Physics Department at Harvard University. Mazur founded several companies and plays an active role in industry. He is the Vice President of the Optical Society.

Dr. Mazur has served on numerous committees and councils, including advisory and visiting committees for the National Science Foundation, and has chaired and organized national and international scientific conferences. He serves as consultant to industry in the electronics and telecommunications industry.

Dr. Mazur is author or co-author of 308 scientific publications, 36 patents, and several books, including the Principles and Practice of Physics (Pearson, 2014), a book that presents a groundbreaking new approach to teaching introductory calculus-based physics. Mazur is a sought-after speaker on optics and on education.

9:45-10:30 April 26····· Plenary Presentation 2
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 2***

Title: Large Optical Telescopes in the Era of Large Wide-field Survey(进入大视场纪元的大型天文望远镜)

Dr. David R. Silva
Director, National Optical Astronomy Observatory (NOAO)
(美国国立光学天文台台长)

Abstract: Since Galileo, building optical telescopes with more and more collecting area has been a high priority for astronomers, in order to investigate fainter and fainter astronomical phenomena in the local and distant Universe. But this is the era of large wide-field surveys, when astronomers are creating rich, complex, multi-wavelength maps of the current Universe as well as how it existed in deep time. Many of these maps have time-domain components, with time resolutions of minutes to years. What scientific roles do current and future large optical telescopes play in this era of large wide-field surveys? This presentation will discuss some possible answers to that question, after a concise summary of current and planned wide-field surveys and their scientific motivations and outcomes.

Principal Author's Biography:

Dr. David R. Silva (BSc, Arizona, 1984; PhD, Michigan, 1991) has been Director of the National Optical Astronomy Observatory (NOAO) since 2008. NOAO is the U.S. national center for ground-based optical and infrared (OIR) astronomy, sponsored by the U.S. National Science Foundation (NSF) and operated by the Association of Universities for Research in Astronomy (AURA). Earlier in his career, Silva worked for the European Southern Observatory (ESO) and the Thirty Meter Telescope (TMT) project where he held various senior academic and management positions. Currently, Silva participates in governance councils for the Gemini Observatory, the Large Synoptic Survey Telescope, and the Thirty Meter Telescope International Observatory. His main astrophysical research interests are extragalactic stellar populations, the formation and evolution of early-type galaxies, and the host stars of exoplanets. His main areas of technical expertise are observatory operations and management, astronomical data processing, and end-to-end data management systems for astronomical observatories. He has authored or co-authored many papers in leading scientific research and technical journals.

11:00-11:45 April 26····· Plenary Presentation 3
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 3***

Title: The European Extremely Large Telescope (E-ELT) Revolution is under construction(欧洲南方天文台极大型天文望远镜—革命在进行中)

Dr. Marc Cayrel
European Southern Observatory (ESO)
Project Manager, E-ELT Optomechanics (欧南台极大望远镜光机总体项目主任)

Abstract: The European Extremely Large Telescope, this giant new ground-based telescope, will have a 39-metre main mirror and will be the largest optical/near-infrared telescope in the world: “the world’s biggest eye on the sky”. The E-ELT programme was approved in 2012 and green light for construction was given at the end of 2014, first light being targeted for 2024.
Construction is now a reality. From the site preparation to the erection of the telescope structures and installation of the complex optical systems and controls, this talk gives an overview of the E-ELT Programme, its status, and the future activities.
The E-ELT is revolutionary in many aspects, in particular regarding its optical design and optical systems. They require the design, fabrication, assembly and test of large, complex, challenging, but robust optics. Many of them will be a ‘world premiere’. Some of them are already being built, the others will soon be contracted. This talk will focus on those E-ELT Optical systems, present their characteristics and design, and give a view of the required developments until their installation and commissioning into the telescope.
Marc CAYREL joined the European Southern Observatory in December 2007 as a member of the European Extremely Large Telescope (E-ELT) Project Office. He is Project Manager for the E-ELT Optomechanics.

Principal Author’s Biography: Marc CAYREL is Senior Optomechanical Engineer, has a background from 15 years experience at REOSC (SAGEM Defense Securite, SAFRAN Group, France), a company specialized in high performance optical systems for space, astronomy, energy, industry, and science.
At REOSC, Marc CAYREL has been the project manager for the manufacturing of the ESO four 8-m monolithic active mirrors for the ESO Very Large Telescope (VLT), the two 8-m monolithic active mirrors for GEMINI observatory, the 11-m segmented mirror for the Gran Telescopio Canarias. He also managed the design and manufacturing of the Beryllium Secondary Mirrors for the VLT, as well as many other projects for Space, Science, and Industry. Marc CAYREL also managed the REOSC’s development of Optical Manufacturing and Testing Processes, the R&D unit, and finally headed the company as General Manager. Before joining ESO, he has been the Deputy Technical Director and Deputy Manager of the Center of Excellence for Optomechanics of SAGEM Defense Securite.
Marc CAYREL is Dipl.-Ing from Ecole Superieure d’Arts et Metiers, France.
Marc CAYREL is giving courses on Optics Manufacturing, and Optomechanics for the Institut d’Optique Graduate School (France).

11:45-12:30 April 26····· Plenary Presentation 4
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 4***

Title: Ultra-precision Lens Fabrication via Moulding: Advances and Challenges(超精密透镜模压制造：前瞻和挑战)

Dr. Liangchi ZHANG (章亮炽)
Scientia Professor
Head of Lab for Precision and Nano Processing Technologies, Fellow of Australian Academy of Technological Science and Engineering (澳大利亚工程院院士，澳大利亚新南威尔士大学精密仪器与纳米加工技术实验室主任，新南威尔士大学学科卓越教授)

Abstract: Using a machining process to make an optical glass component with complex features is costly and time consuming. Precision glass moulding (PGM) has thus been developed to realise an efficient production of aspherical lenses or even irregular optical components in a single step. However, PGM has faced various technical challenges. For example, a PGM process must be carried out within the glass transition region of optical glass above its glass transition temperature, in which the material has an unstable non-equilibrium structure. Within a narrow temperature variation window of 100 °C, glass viscosity can change from 105 Pa•s to 1,012 Pa•s, closely related to the kinetic fragility of the supercooled liquid. This makes a manufacturing process sensitive to the moulding temperature. In addition, because of the structural relaxation in this temperature window, the atomic structure that governs the material properties is strongly dependent on the time and thermal history. Such complexity often leads to shape distortion and residual stresses in a lens moulded, causing unpredictable density and refractive index of a lens moulded. This presentation will describe the thermoforming mechanism of glass lens in PGM, and propose an optimization method for the manufacture of ultra-precision optical lenses by thermal moulding.

Principal Author's Biography:
Liangchi Zhang is Scientia Professor, Professor of Mechanical Engineering, Head of Laboratory for Precision & Nano Processing Technologies, UNSW Australia, and Director of UNSW-XJTU Joint Laboratory for Nano-manufacturing and Measurement Technologies. He has also been an Australian Professorial Fellow. Prof Zhang received his BSc (1982) and MEng (1985) from Zhejiang University,
and his PhD (1988) from Peking University China. He was awarded a higher doctorate degree, Doctor of Engineering (DEng), by the University of Sydney Australia in 2005. In 2006, he was elected the Fellow of the Australian Academy of Technological Sciences and Engineering. Prior to UNSW Australia, he has worked in the University of Cambridge, National Mechanical Engineering Laboratory Japan and University of Sydney; and has been the Director of Graduate School of Engineering and Associate Dean of Engineering at the University of Sydney. Prof Zhang's research emphasizes both fundamentals and applications, and his work has been well received, reflected by the high citations to his publications and by the many academic awards that he has received, including the "B-HERT Award for Best Research and Development Collaboration" and "UNSW Inventor of the Year 2011". He has 7 patents, 6 monographs and more than 450 technical papers. He has been the editor and editorial board member of many international journals. He is currently carrying out research in the interdisciplinary area of precision/nano manufacturing, solid mechanics and characterisation of advanced materials.

13:30-14:15 April 26····· Plenary Presentation 5
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 5***

Title: Advancing Ultra Precision Machining to High Performance(高性能先进超精机床技术)

Dr.-Ing. Oltmann Riemer
University of Bremen (德国不来梅大学精密机床实验室主任)
Head of the Laboratory for Precision Machining co-ordinating and administrating the entire R&D work of LFM

Abstract: In contrast to conventional machining in ultra precision machining all manufacturing operations are very time-consuming and therefore costly. This is getting even more obvious when complex surfaces like free form surfaces or micro-structured surfaces are produced, machining times increase extremely and significant costs come into play. At the first glance this seems to originate from the principal design of the inevitable ultra precision machine components and the dictate of the cutting tools applied, i.e. mono crystalline diamond tools. A closer look at the factors ruling in ultra precision machining reveals that the major downsides can be found within the comparably low material removal rates and the insufficient application of automation techniques. This paper discusses approaches to overcome these drawbacks and advance ultra precision machining to high performance ultra precision machining.
Key Words: ultra precision machining, high performance cutting

Principal Author's Biography:
Dr.-Ing. Oltmann Riemer graduated in 1992 in Mechanical Engineering from the Technical University Braunschweig. Since 1993 he is working as a research engineer and teaching assistant at the Laboratory for Precision Machining LFM at the University of Bremen. He received his Dr.-Ing. degeree at Bremen University in 2001. The focus of his research work is in the area of ultraprecison and micro machining processes, i.e. specifically diamond turning and milling processes, cutting mechanics, micro machining technologies, and micro-topography characterisation. He has published more than 170 scientific papers.
From 2001 to 2004 he was co-ordinating as a general manager the Transregional Collaborative Research Center „Process Chains for the Replication of Complex Optical Elements", a joint research programme between the University of Bremen, the Technical University at Aachen in Germany and Oklahoma State University in Stillwater, OK USA. Since 2005 he is the responsible head of the Laboratory for Precision Machining co-ordinating and administrating the entire R&D work of LFM. He has experience from managing a number of national and international projects, at the same time being principal investigator for various national and European funded projects.
He is teaching courses on Precision Manufacturing for graduate students and he has held tutorials on Ultra Precision Manufacturing Processes at several euspen and ASPE conferences.
Dr. Riemer is member of euspen (European Society for Precision Engineering and Nanotechnology) since 2004 and council member of euspen since 2011. He is a corporate member of CIRP (The International Academy for Production Engineering) since 2010; and a fellow of the International Society for Nanomanufacturing (ISNM) since 2012.

14:15-15:00 April 26····· Plenary Presentation 6
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 6***

Title: Micro/nano Optics for Flexible Functional Devices: Today and Future(微纳光学与柔性电子材料(器件):现状与展望)

Dr. Linsen CHEN (陈林森)
Soochow University
Chief of National United Engineering Research Center of Digital Optical Imaging and Display, and Director of Holography & Optical Information Processing Committee of Chinese Optical Society (数码激光成像显示国家地方联合工程研究中心主任，中国光学学会全息与光信息处理专委会主任)

Abstract: The development of highly functional films and devices with micro/nano-structures plays a significant role in accelerating the application progress of flexible devices. Design and fabrication of novel films and devices with specific functional micro/nano-structure has become a popular trend in industry. But the processes and technologies for flexible electronics devices still have to be improved. Nanoscale feature size and high performance compatible with large format and cost-effective are two key challenges for flexible electronics devices. One issue is the huge data processing, transferring and patterning for large format nano-structure devices. For example, a 6 inch format nano-device with 100nm feature size will have more than 2Tbit data capacity. Different from silicone-based devices, the new technologies must be exploited for flexible substrates, including roll-to-roll nano-manufacturing instead of wafer-to-wafer patterning.
This topic will give an introduction to high rate micro/nano-patterning and approaches and systems for the highly functional films and devices. The novel transparent conductive films with micro-metal mesh structures for large format projected capacitive touch panels and multi-directional backlight for glasses-free 3D display have been investigated based on micro/nano optics. The transparent conductive films of 55 inch low sheet resistance, and directional backlight with 64 viewpoints have been shown and discussed.

Principal Author's Biography:
Chen Linsen, born in 1961, graduated from Soochow University in 1982 and was visiting scholar of Carnegie-Mellon University in 1996-1997. He became a professor in Soochow University since 1998. He is chief of national united engineering research center of digital optical imaging and display, and the director of Holography & Optical Information Processing Committee of Optical Society of China. He has been engaged in holography, micro-nano manufacturing, nano-patterning systems and functional devices for more than 25 years.
He was co-founder and president of SVG Optronics in 2001, who is a stock company in ShenZhen Stock Exchanges of china. He established the Flexible Nanotechnology Platform for merging optics and nanotechnology to promote commercial uses. His research achievements have been applied Chinese identification and driver-license cards, large size flexible touch sensors for touch panels, ultra-thin light guide films for Surface Pro4's keyboard and nano-structure printing for 3D printing industries widely. Due to his contributions to innovation on micro-nano-patterning, the roll-to-roll nano-imprinting technology and the industrial applications, he earned the National S&T Awards(2ndgrad) by Chinese central government in 2001 and 2011, the Innovation Awards for Excellent Chinese Patent in 2010, 2012 and 2015 by SIPO & WIPO, and won the Distinguished Award of Suzhou and Jiangsu in 2008 and 2011, respectively.

15:20-16:05 April 26····· Plenary Presentation 7
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 7***

Title: New Angles on Angle Metrology: Approaching Fundamental Limits(角度测量的新角度：趋近基本测量极限的新方法)

Dr. Ralf D. Geckeler
Physikalisch-Technische Bundesanstalt, Germany
Head of Length and Angle Graduations Group (德国联邦物理技术研究院长度暨角度梯度计量室主任)

Abstract: Precision angle measurement is an important enabling technology with wide-ranging scientific and industrial applications in, e.g., precision engineering, optics, beamline metrology, aerospace, geodesy, and astronomy. Its impressive progress spans at least 3000 years during which it has been improved by approximately six orders of magnitude. Techniques such as circle division and the use of ring lasers involve fundamental physical properties of nature such as discrete and continuous rotational symmetries and challenging approaches to harness them. Angle metrology therefore offers a multitude of facets which are of interest to the metrological community in general.
This talk aims at presenting a wide range of topics in angle metrology, from fundamental questions which provide context and understanding of basic principles to recent applications in precision engineering. It aims to highlight the progress made in approaching fundamental limits in angle measurement as well as the challenges ahead.
With regards to applications, two topics will be presented in more detail. Both are central to harnessing the potential of angle metrology and to approaching fundamental metrological limits. One is the challenge of realizing, maintaining, and disseminating the SI unit of the plane angle at national metrology institutes. The focus will be on the use of angle encoders and methods of realizing angles which are based on the subdivision of the full circle and which make use of circle closure. The full circle therefore represents the fundamental, error-free angular standard. Its division has always been an essential method of realizing the angular scale by means of different cross- and self-calibration methods.
The other topic which will be highlighted is the precision form measurement of optical surfaces by a new generation of angle-based (deflectometric) surface profilometers. For the contactless measurement of the local surface slope, commercial high-resolution autocollimators are used which are capable of providing precise and traceable angle metrology for this purpose. Deflectometric profilometry has turned out to be especially capable of accurately measuring beam-shaping optical surfaces for applications in next generation synchrotron beamlines and Free Electron Lasers (FEL).

Principal Author's Biography:
Dr. Ralf D. Geckeler received his PhD from the Eberhard-Karls University, Tübingen, Germany. He heads the Length and Angle Graduations Group at PTB, the national metrology institute of Germany. His research focuses on angle measuring devices, such as autocollimators and angle encoders, in international collaboration with industry and research institutes. Current topics include the improvement of autocollimator performance and calibration, the advancement of angle metrology for the characterisation of beamline optics at synchrotron and FEL facilities worldwide, and the development of novel methods and advanced mathematical algorithms for the calibration of angle measuring devices.

16:05-16:50 April 26····· Plenary Presentation 8
GREAT HALL OF THE PEOPLE (苏州国际会议中心 大会堂)

■ ***Plenary Presentation 8***

Title: Functional Photonic Nanostructures：From Thin Films and Slits to Catenaries(功能性光子学纳米结构：从薄膜、狭缝到链状网)

Dr. Xiangang LUO (罗先刚)
Vice President of Institute of Optics and Electronics, CAS
Director of State Key Laboratory of Optical Technologies for Nano-Fabrication and Micro-Engineering(中国科学院光电技术研究所副所长，微细加工光学技术国家重点实验室主任)

Abstract: Nano-structured materials have shown their superior properties when integrated in optical systems. Besides the relatively mature technologies such as anti-reflection or optical filter based on thin dielectric films, recent years have witnessed the rapid development of the metallic thin films and nanostructures, partly because the rise of plasmonics- the study of the interaction between electromagnetic field and free electrons in a metal. In this talk I would like to give a concise discussion of the novel nanostructures investigated by my groups.

Firstly, I would like to give some time to the thin metallic films. Different from their dielectric counterparts, the metallic films possess many exotic electromagnetic properties, which make them a promising candidate to revise the traditional optics. On the one hand, it has been shown that the surface plasmons excited on the two sides of a metallic thin film can couple together and lead to a dramatical reduction of the effective wavelength [1]. This extremely short-wavelength property enables such films to be used in super-resolution imaging and sub-diffraction lithography. On the other hand, we have shown that a thin metallic film with thickness down to 0.3 nm can be used to absorb virtually all the electromagnetic energy, when some coherent condition is met [2]. This ultrathin and broadband absorber can be regarded as a big step towards the realization of the true blackbody absorber introduced by Gustav Kirchhoff in 1860.

As the propagation constant of the surface plasmon wave is dependent on the thickness of the metallic film, films with different thickness can be used as optical delay lines to shape the wavefronts of light beams and route the light signals to desired locations. Based on the Babinet's principle, we show that the Babinet-inverted films, i.e., the nanoslits perforated in metallic screen, could serve as a flat lens with negligible spherical aberrations [3]. Furthermore, we revealed that there are two different mechanisms in nanoslits to mold the phase of light. Besides the plasmonic phase delay, an additional rotate of the nanoslits would introduce a geometric phase, which is mainly determined by the rotation angle and the helicity of the illuminating light. A recent demonstration of the two physical problems in a natural catenary structure will also be discussed [4]. Owing to the continuous structures and specific geometry, the optical catenaries can operate in an ultra-broadband spectrum, which is beyond the capability of previous structures.

Principal Author's Biography:

Xiangang Luo is the Professor at The Institute of Optics and Electronics, Chinese Academy of Sciences and the Director of State Key Lab of Optical Technologies on Nanofabrication and Micro-engineering. Professor Luo received Ph.D from Chinese Academy of Sciences (2001). Professor Luo's current research focused on micro-nano-optics, subwavelength optics. He has published more than 200 technical papers and 100 patents in optics related fields. He has been a Program Leader and Chief Scientist of the National Key Basic Research and Development Program.

Invited Talks [1-0009] Session 1-1

Title: Progress of indirect slumping technology development at MPE for lightweight X-ray optics

Mingwu Wen
Max-Planck Institute for Extraterrestrial Physics

Abstract:
Large X-ray telescopes for future observatories need to combine a big collecting area, meaning large mirrors diameter, with good angular resolution, meaning structures stiff enough to guarantee the correct profiles and positioning of such mirrors. Due to the mass limits of the launching rocket, lightweight materials and configurations are required in order to allow their manufacturing. The Slumped Glass Optic (SGO) group of the Max Planck Institute for Extraterrestrial physics (MPE) is developing the indirect slumping technology to address the need. This technique foresees the shaping at high temperature of thin glass foils, originally flat, to the Wolter I design of X-ray mirror segments, by using suitable moulds. During the thermal cycle inside electrical ovens the glass viscosity is such to allow its bending onto the mould so to replicate its shape still maintaining the original micro-roughness of the glass. This replication process is particularly indicated for the manufacturing of several identical optical elements, which can successively be coated with the necessary reflective layer before their alignment and integration into supporting structures. Numerous aspects of the technology have been studied in the past, such as the selection of mould and glass materials, the optimization of the thermal cycle parameters and set-up, the application of reflective layer on the mirror segments, and their integration into elemental X-ray optical units. The current results and status of activities will be presented in the paper.

Keywords: indirect slumping technology, Fused Silica mould, Slumped Glass Optic

Biography:
Mingwu Wen is a Ph.D. student in Institute of Precision Optical Engineering (IPOE) of Tongji University. His main research interest is EUV and soft X-ray multilayers. Since September 2015, he joined the high energy group of Max-Planck Institute for Extraterrestrial physics (MPE) for a one-year joint training project, working on the development of the glass slumping technology and thin mirrors characterization for X-ray telescope manufacturing.

Invited Talks [2-0065] ····· Session 2-1

Title: Closing the metrology / process loop in CNC polishing

Authors

1. **David Walker**, University College London, University of Huddersfield, Glyndwr University and Zeeko Ltd
2. Guoyu Yu, Glyndwr University
3. Matt Bibby, Zeeko Ltd
4. Hongyu Li, Glyndwr University
5. Christina Dunn, University College London

Abstract

We have previously described our work combining industrial robots and CNC polishing machines in a Cell, where a robot can play the dual roles of automating manual operations on the CNC platform(s), and provide an effective smoothing capability in its own right. We have drawn attention to the complementary properties of standard CNC and robot platforms, in regard to speed, acceleration and precision of motion, and first resonant frequency. In this paper, we report on new work extending the scope of a Cell to incorporate a metrology station, and demonstrate how the transfer and alignment of the part, and acquisition of metrology data, can be very effectively automated. We have also demonstrated an automated ability to probe the part on-machine and then incorporate the probing data in the CNC control file. The purpose of this is to assure true registration of the CNC coordinate frame with that of the part. These advances constitute key developments towards our ultimate vision of a fully autonomous manufacturing cell. The distinguishing features are i) the iterative nature of the processes deployed, where details of each process-step depend on analysis of the output of the preceding step, and ii) the flexibility in manufacturing a wide range of different parts.

Biography:

Professor Walker is Professorial Research Associate at University College London, Professor of Optics at Glyndwr University, and Visiting Professor at the University of Huddersfield. He formed the Optical Science Laboratory at UCL in the early 1990's, developing astronomical instrumentation and sub-systems for some of the world's largest astronomical telescopes. In 2004 he led establishment of the National Facility for Ultra-Precision Surfaces at the OpTIC Centre in North Wales, and has been based there since. His current research focusses on advanced processes for optical fabrication and metrology, and in particular, process-automation. He works on the boundary between university-research and industrial-exploitation, was co-founder of the CNC polishing machine company Zeeko Ltd in 2000, and is its current Research Director. Professor Walker was awarded the 2014 Optics and Photonics Prize by the UK Institute of Physics, in recognition of his work both on astronomical instrumentation and technology-transfer. He is a Senior Member of SPIE.

■ Invited Talks [7-0030]····· Session 7-1

Title: Nano-Metrology at Diamond Light Source

Kawal Sawhney, Simon Alcock, Hongchang Wang, Ioana Nistea and Yogesh Kashyap
Diamond Light Source Ltd, Harwell Science and Innovation Campus, Didcot, OX11 0DE, UK

Abstract: There are currently more than 30 beamlines in operation or construction at Diamond Light Source, all of which employ a range of high-quality optics to focus the synchrotron X-ray beams. Increasingly, substrates with slope errors of <100 nrad rms are required for grating blanks, pre-polished mirrors, and active optics such as mechanically bent or piezo deformable bimorph mirrors. Both ex-situ (optical interferometry or deflectometry) and in-situ (using X-rays) metrology techniques are employed at Diamond to characterize and optimize such demanding optics [1]. Diamond's metrology lab is equipped with a suite of nano-metrology instruments, most notable the Diamond-NOM [2] slope measuring profiler, Fizeau interferometer, and the recently acquired stitching micro-interferometer [3]. Such instruments can provide accurate measurement of optical surfaces with sub-nanometer levels of repeatability. High quality metrology data can also be used as feedback to improve the final quality of X-ray synchrotron optics, either by iterative cycles of deterministic polishing or during clamping of the optics in their opto-mechanical holders. Ex-situ metrology is performed at Diamond's versatile B16 Test beamline. Importantly, an unprecedented angular sensitivity in the range of two nanoradians has been demonstrated with the speckle based metrology technique [4, 5]. In this presentation, an overview of the nano-metrology capabilities at Diamond will be presented including representative examples of testing <100 nrad rms slope error optics.

Biography:
Kawal Sawhney did his Masters in Physics from the University of Delhi and PhD from the University of Indore, India. He undertook post-doctoral work in the field of X-ray Optics at BESSY-II in Germany. He is currently heading the Optics and Metrology Group at the Diamond Light Source, UK. He is also the Principal Beamline Scientist for Diamond's Test beamline B16. Prior to joining Diamond in 2004, Kawal was head of the Beamlines Section at the Indian synchrotron facilities Indus-1 and Indus-2, where he oversaw design, construction and operation of several beamlines. Kawal has more than 25 years of experience on a wide range of x-ray instrumentation and optics for synchrotron applications. He has also authored more than 110 scientific publications. His group provides expertise to the Diamond beamline scientists in the design, acceptance and measurement of beamline optics; and the development of novel X-ray optics. His main interests are in designing beamline optics and carrying out research in the field of x-ray optics and metrology for x-ray optics.

Invited Talks [7-0011] Session 7-1

Title: The new BESSY-II Optics Laboratory - a Facility for Measuring X-Ray Optics of sub-50nrad Precision

Frank Siewert[1], Jana Buchheim[1], Grzegorz Gwalt[1], Ivo Rudolph
Helmholtz Zentrum Berlin für Materialien und Energie, Institut für Nanometer Optik and Technologie, Albert-Einstein-Str. 15, D-12489 Berlin, Germany

Abstract: The BESSY-II Optics Laboratory (BOL) at the BESSY-II storage ring of the Helmholtz Zentrum Berlin (HZB) has recently moved to a new laboratory space. Since the end of 2015, it is located in a dedicated clean-room providing environmental and instrumental conditions essential to measure and characterize ultra-precise X-ray optical components like synchrotron mirrors or reflection gratings. Besides optical elements for beamlines at the BESSY-II storage ring, the BOL serves several further facilities that lack dedicated on-site optical metrology capabilities, including the new MAX-IV synchrotron in Lund (S), the European XFEL as well as PETRA-III, and the FLASH VUV-FEL at DESY in Hamburg (D). One of the major tasks of BOL, beside the acceptance test of optics, is to support the figure optimization of optics as well as the development and optimal beamline use of X-ray optical elements. Different instruments, like the Nanometer Optical component measuring Machine (NOM) for the measurement of slope deviation, a 18-inch-Fizeau interferometer, a White Light Interferometer (WLI), different atomic force mircroscopes (AFM) and a vibrometer available in the lab enable separate, often complementary investigations of optical elements and systems, including mechanics. These different instruments allow to characterize optics on a wide range of spatial frequency from a few nanometer up to the full aperture length of more than one meter. We will review the current state of the lab, discuss latest developments on the characterization of instrument performance as well as report on latest measurement results of the characterization of state of the art sub-50nrad rms precise synchrotron optics.

Biography:
Frank Siewert received his Dipl-Ing. (TU) in metallurgy and material sciences from the Technical University Bergakademie Freiberg (Germany) in 1989. From 1989 to 1991, he was working in the field of Powder Metallurgy at the BMHW in Berlin. He then joined the DLR-Institute for Space Sensor Systems in Berlin working on the CASSINI – Cosmic Dust Analyzer from 1991 to 1995. From 1996 to 2000 he was with O&K Optikkomponenten & Kristalle developing finishing technology for crystal materials. Since 2000 he is a staff scientist at the BESSY-II synchrotron of HZB. Since 2006 he is responsible for the BESSY-II Optics Laboratory. Currently he is in the position of the Deputy Director of the Institute for Nanometer Optics and Technology at Helmholtz Zentrum Berlin. He has authored more than 90 scientific publications. For his contribution to the development of the Nanometer Optical Component Measuring Machine (NOM) he received the “European Innovation Award on Synchrotron Radiation” 2009.
In 2015 he was awarded with the “Giovani Sostero Award” on metrology for X-Ray Optics. His current research interest is in the field of x- ray optics, SR-and FEL-Instrumentation, and metrology.

Invited Talks ····· Session 7-1

Title: Development of optical metrology at SSRF

Wang Jie, He Yumei, Luo Hongxin, Xiao Tiqiao
(Shanghai Synchrotron Radiation Facility, 239 Road Zhangheng, Shanghai, China, 203204)

Abstract: Greater demands are being placed on X-ray mirrors of beamlines of 3rd generation synchrotron radiation. Figure errors much less than 1 μrad are considerably required for nanometer focusing and/or coherence preserving of hard X-ray beams. State-of-the-art beamlines reap benifits from development of both mirror manufacturing and optical metrology. At SSRF, a dedicated optics metrology laboratory for 1st phase beamlines provides common capability of optics tests. A home-made LTP-1200 and SSRF-NOM are developed in 1995 and 2015 respectively.
Measurement uncertainty of the LTP reaches 0.83μrad and the NOM 64nrad. Surface roughness can be tested by the ZYGO surface profiler using different microscopic objective lens，which gives roughness of a few Angstroms over areas of 0.2~0.5mm². For Project Phase-II, more metrology instruments need. A NOM combined with a LTP for sideward and downward mirrors is under design. A 2D optical test machine based on Shack-Hartmann sensor will be developed as well. Optical elements, such as gratings, zone plates, can be measured using scanning AFM and/or contact profiler. Besides optical metrology, an X-ray test beamline under construction enables possibly at-wavelength testing.

Biography:
Dr. Wang Jie received his doctor degree at Shanghai Institute of Optics and Fine Mechanics, CAS, in 1995. He was with National Synchrotron Radiation Laboratory, University of Science and Technology of China. Now he works at Shanghai Synchrotron Radiation Facility, Shanghai Institute of Applied Physics as optics group leader and head of Beamline Optical Engineering Division.

Invited Talks [7-0024] ····· Session 7-1

Title: Metrology for x-ray optics: current capabilities, new challenges, and tasks for further developments (The ALS X-Ray Optics Lab's eye view)

Valeriy V. Yashchuk* and Gary Centers
Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, California 94720

Abstract: The advent of fully coherent free electron laser and diffraction limited synchrotron radiation storage ring sources of x-rays is catalyzing the development of new ultra-high accuracy metrology methods. To fully exploit these sources, metrology needs to be capable of determining the figure of an optical element with sub-nanometer height accuracy. The major limiting factors of the current absolute accuracy of ex situ metrology are systematic errors inherent to the metrology instruments. Here, we discuss in detail the work at the Advanced Light Source (ALS) X-Ray Optics Laboratory (XROL) on development of advanced experimental methods and techniques to suppress, measure, and eliminate the instrumental systematic errors that is a fundamental avenue to the progress in ultra-high accuracy ex situ metrology for x-ray optics. With a few examples, we show how the developed methods allow us to significantly gain capabilities and performance of the existing lab instruments used for characterization and optimal tuning of high quality x-ray optics. We will also review the ALS XROL plans for instrumentation upgrades and development of sophisticated methods for metrology data processing and usage. The discussion will be illustrated with the results of a broad spectrum of measurements of x-ray optics and optical systems performed at the lab. Supported by the U. S. Department of Energy under contract number DE- AC02-05CH11231.
Keywords: x-ray optics, optical metrology, surface slope profilometry, LTP, surface interferometry, microscopy, error reduction, calibration

Biography:
Valeriy V. Yashchuk received his MS degree in experimental physics from St. Petersburg State University (Russia) in 1979, and his PhD degree from St. Petersburg Nuclear Physics Institute (Russia) in 1995. He is currently leading the X-Ray Optics Laboratory at the Advanced Light Source, Lawrence Berkeley National Laboratory. He has authored and coauthored more than 150 scientific publications in the fields of atomic and molecular physics, nonlinear optics, electro- and magneto-optics, laser spectroscopy, experimental scientific methods and instrumentation, and optical metrology. In 1986 for the development of a method of reduction of phase space of an atomic beam he was awarded the Leningrad Komsomol Prize in physics. In 2007 and 2015, he received R&D Magazine's R&D 100 Awards for development of Laser-Detected MRI and Binary Pseudo-Random Calibration Tool, respectively. His current research interest is in x-ray optics, optical instrumentation and metrology for x-ray optics. He is the OSA Fellow and a member of SPIE and APS.

Invited Talks [7-0010] Session 7-2

Title: Comparison of small-angle deflectometric measurements with different apertures down to the sub-millimetre range

Gerd Ehret, Susanne Quabis, Michael Schulz
Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig, Germany

Abstract: Small-angle deflectometers or slope profilers are capable of measuring the form of slightly curved surfaces, e.g. synchrotron or free electron laser mirrors, with nanometre or even sub-nm accuracies. The term 'small-angle deflectometry' is used to differentiate this principle from other deflectometric methods such as fringe projection. Typically, these small-angle deflectometers use commercially available autocollimators (ACs) with apertures in the multi-millimetre range, and furthermore, there is no established procedure for small-angle deflectometry with lateral resolution better than 2 mm. Now, PTB has developed and set up a deflectometer with sub-millimetre lateral resolution. To this end, we use an enhanced deflectometric method, the so-called 'Exact Autocollimation Deflectometric Scanning' (EADS) mode [1, 2] which makes use of two angle sensors. The first angle sensor has a small beam aperture and scans the specimen by using a pentaprism. It operates as a null angle sensor. It controls the tilting of the specimen by means of a piezo actuator, so that the reflected beam of the specimen always propagates back in the same direction.
The tilt of the specimen is measured by the second angle sensor – usually a commercially available autocollimator – with a large aperture at a fixed distance. By the numerical integration of the measured tilt angles, the surface topography is obtained. We developed different types of null angle sensors with submillimetre apertures and with sensitivities of better than 0.01 arcsec [3]. The measurement uncertainty associated with the resulting topography typically scales with the scan length and with the inverse spot size of the scanning beam. In this paper examples of measurements with different lateral resolutions down to the sub-millimetre range are presented, compared and discussed with an emphasis on the dominant error influences and the resulting measurement uncertainties.

Biography:
Dr. Gerd Ehret is researcher in the Physikalisch-Technische Bundesanstalt (PTB), Germany, in the working group "Form and Wavefront Metrology" and is currently setting up a globally unique flatness measurement system with sub-nanometre height uncertainty in combination with sub-millimetre lateral resolution. He investigates promising new deflectometric approaches to measure also curved surfaces with high accuracy. He has more than 12 years experience in optical metrology (optical flatness/form metrology, optical microscopy, optical rigorous and raytrace modelling, improving of optical antireflexion) and published more than 50 scientific papers in this Field.

■ Invited Talks [7-0017]····· Session 7-2

Title: Development of slope sensor for long trace profiler

Yasunori Senba, Kouto, Sayo-cho, Sayo-gun, Hyogo
JASRI, Light Source and Optics Division, Japan

Abstract: Surface measurement apparatus, long trace profiler (LTP), is used at most synchrotron radiation facilities for evaluation of X-ray optics. The LTP is characterized by a long scan length, noncontact and direct measurement of slope, and is consists of movable penta-mirror and optical slope sensor. In recent years well-calibrated autocollimator is used as a slope sensor to achieve high accuracy of 50 nrad, which is called nanometer optical component measuring machine (NOM)[1]. The optics used in synchrotron radiation and x-ray free-electron laser requires small shape error of less than 10 nm along length of the surface in all spatial frequency bandwidths to avoid disturbance of wavefront of reflected beam. In order to evaluate such optics, absolute surface measurement with high accuracy of less than 50 nrad and small probe diameter of less than 1 mm is required.
Aiming at achieving high accuracy and small probe, we have been developing a new laser based sensor. The calibration and performance test has being carried out using high-precise closed-loop controlled piezo actuator stage. We will report the current status of the LTP at SPring-8 and the laser based sensor.

Biography:
Yasunori Senba was born in Ehime, Japan in 1973 and received a MSc (1998) and a PhD at the Hiroshima University, Japan (2001). He is currently a researcher at Japan Synchrotron Radiation Research Institute (JASRI) in SPring-8.
His research interests are design of soft x-ray beamline and x-ray optics metrology for synchrotron radiation facilities.

■ Invited Talks[7-0021]····· Session 7-2

Title: Optical Metrology at BSRF

Ming Li
Institute of High Energy Physics, Chinese Academy of Sciences

Abstract: The High Energy Photon Source is now proposing to Chinese Government. Its designed emittance reached the diffraction limit level. It requires extremely harsh surface accuracy. In order to cope with the situation, The High Energy Photon Source Test Facility is developing optical metrology as a key technology. This talk will introduce the surface accuracy requirement of High Energy Photon Source on the mirror, and design and development progress of Long Trace Profiler and Stitching Interferometer at Beijing Synchrotron Radiation Facility.

Biography:

Dr. Li Ming, Optics Group leader of BSRF, now is responsible for the optical metrology of HEPS.

Invited Talks [7-0023] ····· Session 7-3

Title: Spring correctors for nanometer figure correction of x-ray mirrors

Josep Nicolas*[1], Carles Colldelram[1], Claude Ruget[1], Llibert Ribó[1], Carlos Martín-Nuño[2], David Úbeda[2], Albert Tomàs[2]

[1]ALBA Synchrotron, Carrer de la Llum 2-26, 08290 Cerdanyola del Vallès, Barcelona, Spain.

[2] Sener Ingenieria y Sistemas, Carrer Creu Casas i Sicard 86, 08290 Cerdanyola del Vallès, Barcelona, Spain

Abstract: The figure of an x-ray mirror can be corrected or adapted to the incident wavefront by means of controlled deformations of the substrate. This requires the resolution of the induced deformations to be of the order of one nanometer; and therefore actuators capable of providing such resolution are needed. Some existing systems use high-resolution positioning actuators to set a geometric constraint on the mirror substrate that allows obtaining he desired surface figure. Alternatively, we propose a system in which nanometer resolution is achieved by means of a force constraint on the mirror substrate. In this case, the resolution can be reached by regular although high precision mechanics. We analyze the performances on the force actuators, in terms of force range, resolution and stability required to provide and maintain the correction at the nanometer level. We describe a mechanical concept that achieves it, and report the results of the metrology of a prototype implementing the proposed design.

Biography:

Josep Nicolas obtained his degree in Physics by the Universitat Autònoma de Barcelona in 1996. In 2003 he obtained his PhD in Physics at the Optics group of the same University. His research was focused in optical image processing, color information, polarization and metrology. He joined the ALBA project in 2003, and he was involved in the design and construction of the three soft x-ray beam lines of the initial phase of the facility. He was also in charge of developing the optics and metrology laboratory of the facility. He is currently the head of Optics, Metrology and Support section, and he is strongly involved in the design and development of new beam lines. His research interests include metrology, beamline design and x-ray optical instrumentation.

Conference 1: Large Mirror and Telescopes

Conference Chairs:

Myung . Cho, National Optical Astronomy Observatory (USA)

Bin FAN(范 斌), Institute of Optics and Electronics, CAS (China)

8:30-12:00 April 27 ····· SESSION 1-1
FENGLE HALL 丰乐厅 (20 min/report)

Session chair:WU Fan(伍凡), IOE

- ✓ Design and analysis of a 2-DOF rotational flexure mechanism for the mirror sub-assembly of future inertia confinement fusion facility, Baoxu WANG, et al. (汪宝旭, 中物院总体所)(China) ····· [1-0003]
- ✓ Study on error budget of large deployable optical remote sensor, Yan LI, et al. (李岩, 北京空间机电研究所)(China) ····· [1-0006]
- ✓ Progress of indirect slumping technology development at MPE for lightweight X-ray optics, Mingwu Wen, et al. (Mingwu Wen, Max-Planck Institute for Extraterrestrial Physics)(Germany) ····· *(invited)* [1-0009]
- ✓ The application of active optics on large space laser three-dimensional imaging radar to compensate the aberration induced by space environment, Xin WANG, et al. (王欣, 上海技术物理研究所)(China) ····· [1-0017]

Tea Time

- ✓ The gravity and thermal deformation of large primary mirror in space telescope, Xin WANG, et al. (王欣, 上海技术物理研究所)(China) ····· [1-0019]
- ✓ Fabrication and Testing of M3MP FOR TMT, Xiao LUO, et al. (罗霄, 长春光机所)(China) ····· [1-0059]
- ✓ Research on sub-surface damage and its stress deformation in the process of large aperture and high diameter-to-thickness ratio TMT M3MP, Haixiang HU, et al. (胡海翔, 中科院长春光机所)(China) ····· [1-0067]
- ✓ Application of Scanning Pentaprism System on Manfacturing of M3MP, Erhui QI, et al. (戚二辉, 中国科学院长春光机所)(China) ····· [2-0080]

13:00-17:00 April 27 ····· SESSION 1-2
FENGLE HALL 丰乐厅(20 min/report)

Session chair: FAN Bin(范斌), IOE

- ✓ Experimental study on grinding wheel wear and compensation of 5-Axises grinding extremely large 4m reflective mirror using a cone grinding wheel, Yingjie LI, et al. (李英杰, 长春光机所)(China) ····· [1-0022]
- ✓ Research on New-style Flexure Supports Process for Large-aperture Laser Transport Mirrors Mounting, Xusong QUAN, et al. (全旭松, 激光聚变研究中心)(China) ···· [1-0023]
- ✓ Hydraulic supports for polishing TMT M3MP, Haifei HU, et al. (胡海飞, 中科院长春光机所)(China) ····· [1-0050]
- ✓ modeling and control of the driving system of slant mount telescopes , Wangping ZHOU, et al. (周旺平, 南京信息工程大学)(China) ····· [1-0032]

Tea Time

- ✓ An Improved ADRC Algorithm and Its Application, Dan ZUO, et al. (左丹, 中科院光电所)(China) ····· [1-0037]
- ✓ Pre-Construction Progress of Giant Steerable Science Mirror for TMT, Fei YANG, et al. (杨飞, 中科院长春光机所)(China) ····· [1-0043]
- ✓ Thirty Meter Telescope Tertiary Mirror System Prototype Cell Assembly analysis and fabrication, Peng GUO, et al. (郭鹏, 中国科学院长春光机所)(China) ····· [1-0054]
- ✓ Encoder System Design and Error Compensation in GSSMP, Hongchao ZHAO, et al. (赵宏超, 中科院长春光机所)(China)····· [1-0060]
- ✓ ANALYSIS OF CRACK FRACTURE MECHANISM DUE TO SEQUENTIAL INDENTATION TESTS ON SAPPHIRE, Ningchang WANG, et al. (王宁昌, 华侨大学)(China)····· [1-0063]

Conference 2: Advanced Optical Manufacturing Technologies

Conference Chairs:

Wenhan JIANG(姜文汉), Academician, Chinese Academy of Engineering (China)

Li YANG(杨力), COMT, COS (China)

Oltmann Riemer, Head of the Laboratory for Precision Machining

Shengyi LI(李圣怡), National University of Defense Technology (China)

Yongjian WAN(万勇建), Institute of Optics and Electronics, CAS (China)

8:30-12:00 April 27 ····· SESSION 2-1
LONGFENG HALL 龙凤厅 (15 min/report)

Session chair: Yongjian WAN (万勇建), IOE

- ✓ Closing the metrology/process loop in CNC polishing, David Walker, et al. (David Walker, Glyndwr University)(Glyndwr University) ····· *(invited)*[2-0065]
- ✓ Numerical investigation of the performance of aerostatic journal bearings, Xinkuan WANG, et al. (王新宽, 上海交通大学)(China) ····· [2-0004]
- ✓ In-process electrical discharge dressing of arc-shaped metal bonded diamond wheels, Kai WANG, et al. (王凯, 中物院材料研究所)(China) ····· [2-0009]
- ✓ Algorithm and strategy of the suppression of the mid-spatial error in the Magneto-rheological Finishing, Yang JIA, et al. (贾阳, 中国工程物理研究院)(China)[2-0014]
- ✓ Manufacturing progress of production of high aspherical axis and off-axis astronomical and space optics for the last decade, Aleksandr P. Semenov, et al. (Aleksandr P. Semenov, JSC LZOS)(Russia) ····· [2-0020]
- ✓ Vacuum system for applying reflective coatings on large-size optical components using the method of magnetron sputtering, Alexander A. Azerbaev, et al. (Alexander A. Azerbaev, JSC “Lytkarino Optical Glass Factory” (JSC LZOS))(Russia)····· [2-0022]

Tea Time

- ✓ Fluid field characteristics analysis of rectangular-nozzle aspect change, Shaogui ZUO, et al. (芈绍桂, 中物院激光聚变中心)(China)····· [2-0018]
- ✓ Remove Zonal errors on large aspheric SiC mirror with multi-mode technique, Zhenyu LIU, et al. (刘振宇, 长春光机所)(China)····· [2-0027]
- ✓ Optical Material Removal Property Analysis of Ar+ and Kr+ in Ion Beam Figuring, Ying LU, et al. (鹿迎, 国防科大)(China) ····· [2-0031]
- ✓ Detection of the subsurface damage in potassium dihydrogen phosphate crystals using the grazing incidence X-ray diffraction method after machining, Ning HOU, et al. (侯宁, 哈尔滨工业大学)(China) ····· [2-0033]
- ✓ Influence of flexility of polishing tool on the microscopic figure of spinel surface and optimal design, Zhiming WU, et al. (吴志明, 国防科技大学)(China)····· [2-0039]
- ✓ Rapidly Removing Grinding Damage Layer on Fused Silica by Inductively Coupled Plasma Processing, Heng CHEN, et al. (陈恒, 国防科技大学)(China) ····· [2-0044]

13:00-17:00 April 27 ····· SESSION 2-2
LONGFENG HALL 龙凤厅 (15 min/report)

Session chair: Qiang CHEN (陈强), IOE

- ✓ Fabrication of off-axis aspheric substrate couple with large relative aperture, Jun YU, et al. (余俊, 同济大学)(China) ····· [2-0045]
- ✓ High-precision structure fabrication based on an etching resistance layer, Man ZHANG, et al. (张满, 中科院光电技术研究所)(China)····· [2-0047]
- ✓ V Groove Ruling Technologies by with Diamond Tool, Ketian LI, et al. (李克天, 广东工业大学)(China)····· [2-0049]
- ✓ Method of Smoothing An Aspheric Surface with Sub-mm Departure, Jian ZHANG, et al. (张健, 长春光机所)(China) ····· [2-0050]
- ✓ Research on thickness uniformity correction of reflective coating by IBF, Yongqiang GU, et al. (谷勇强, 中科院长春光机所)(China) ····· [2-0053]
- ✓ Investigation of the atomic emission spectroscopy of F atoms and CF2 molecules in CF4 plasma processing, Huiliang JIN, et al. (金会良, 成都精密光学工程中心)(China)[2-0062]

Tea Time

- ✓ Development status of Active Disturbance Rejection Control, Hong YUAN, et al. (袁洪, 清华大学深圳研究生院)(China) ····· [2-0068]
- ✓ Study of Fabrication Large Aperture SiC Stitching Flat Mirror, Ang LI, et al. (李昂, 北京空间机电研究所)(China)····· [2-0071]
- ✓ Polishing an off-axis aspheric mirror by ion beam figuring, Yonggang WANG, et al. (王永刚, 北京空间机电研究所)(China) ····· [2-0072]
- ✓ Dynamic aberration correction for conformal optics using model-based wavefront sensorless adaptive optics, Xinli HAN, et al. (韩新丽, 北京理工大学光电学院)(China)[2-0074]
- ✓ Research on robot navigation vision sensor based on grating projection stereo vision, Xiaoling ZHANG, et al. (张晓玲, 江苏理工学院)(China) ····· [2-0076]
- ✓ Three-dimensional thermal modeling of wafer based precision glass molding process, Yang HU, et al. (胡杨, 中国科学技术大学)(China) ····· [2-0078]

8:30-12:00 April 28 ····· SESSION 2-3
LONGFENG HALL 龙凤厅 (15 min/report)

Session chair: Xi HOU (侯溪),IOE

- ✓ Ultra-precision deterministic processing algorithm and experiment research of FJP, Zongfu GUO, et al. (郭宗福, 湖南大学)(China) ····· [2-0089]
- ✓ Study on manufacturing method of optical surface with high accuracy in high accuracy, Zuo YU, et al. (于鑫, 天津 8358 研究所)(China) ····· [2-0090]
- ✓ Optimization of a NURBS curve for designing progressive contact lens, VU THI LIEN, et al. (VU THI LIEN, National Taiwan university of science and technology)(Vietnam) ····· [2-0092]
- ✓ Method for ion beam etching in angles with multi-layers model, Siwei ZENG, et al. (曾思为, 中国科学技术大学)(China) ····· [2-0095]
- ✓ λ/100 reference flat for commercially available Fizeau interferometer, Yohan Kondo, et al. (Yohan Kondo, National Institute of Advanced Industrial Science and Technology (AIST))(Japan) ····· [2-0103]

Tea Time

- ✓ Study on Optical Fabrication and Metrology of Precise Convex Aspheric Mirror, Huijun WANG, et al. (王慧军, 北京空间机电研究所)(China) ····· [2-0106]
- ✓ a high acuuracy method for correction of tool offset position in SPDT, Yi WANG, et al. (王毅, 苏州大学)(China) ····· [2-0108]
- ✓ Research on the atmospheric pressure plasma processing of continuous phase plate, Peng ZHANG, et al. (张鹏, 哈尔滨工业大学)(China) ····· [2-0111]
- ✓ Effect of silicon carbide ceramic coating process on the mirror surface quality, Peipei WANG, et al. (王培培, 北京空间机电研究所)(China) ····· [2-0112]
- ✓ Development of Atmospheric Pressure Plasma Processing Machine Tool for Large Aperture Optics, Xing SU, et al. (苏星, 哈尔滨工业大学)(China) ····· [2-0113]
- ✓ Effection of Grinding System Rigidity Ultra-precision Grinding of Aspheric Mould and Error Compensation , Shaohui YIN, et al. (尹韶辉, 湖南大学)(China) ····· [2-0114]

Conference 3: Optical Test, and Measurement Technology, and Equipments

Conference Chairs:

Yudong ZHANG(张雨东), Institute of Optics and Electronics, CAS (China)

Fan WU(伍凡), Institute of Optics and Electronics, CAS (China)

Ming XU(徐敏), FuDan University

Sandy To, Hong Kong Polytechnic University (China Hong Kong)

8:30-12:00 April 27 ····· SESSION 3-1
HEHE HALL 和合厅 (10 min/report)

Session chair: WEN Shangming(温尚明) ,IOE

- ✓ Test Diffraction Properties of Reflection Waveguide Holograms, XIE Yi, et al.(谢意，东南大学)(CHINA) ····· [3-0008]
- ✓ Mount-induced wavefront distortion measurement of large optical array modules, Haixian YE, et al. (叶海仙，中国工程物理研究院)(China) ····· [3-0004]
- ✓ Research on the photoelectric measuring method of warhead fragment velocity, Ji LIU, et al. (刘吉，中北大学)(China)····· [3-0006]
- ✓ Near infared reflective shearing point diffraction interferometer for dynamic wavefront measurement, Wenhua ZHU, et al. (朱文华，南京理工大学电光学院)(China)[3-0009]
- ✓ Research on adjusting and testing of off-axis paraboloid mirror with large aperture, Dongzuo ZHENG, et al. (郑东晖，南京理工大学电光学院)(China)····· [3-0010]
- ✓ High Precision Calibration of Laser Line Scanners Based on Linear Transformation Over Triangular Domain, Hua LI, et al. (李玥华，河北科技大学)(China) ····· [3-0014]
- ✓ Annular sub-aperture stitching interferometry testing for large-caliber aspheric, Pengfei WU, et al. (吴鹏飞，西安交通大学)(China) ····· [3-0020]
- ✓ Synchronous two-wavelength temporal interferometry, Xiaoqiong ZHANG, et al. (张小琼，北京交通大学)(China) ····· [3-0031]

Tea Time

- ✓ Design of a photoelectron/ion imaging spectrometer with high temporal resolution, Yuzhu LIU, et al. (刘玉柱，南京信息工程大学)(China) ····· [3-0032]
- ✓ Manufacture, alignment and measurement for a reflective triplet optics in imaging spectromter, Liyin YUAN, et al. (袁立银，上海技术物理研究所)(China)····· [3-0033]
- ✓ Scanning Electron Microscopy Measuring Method Based on Laser Interference principle, Bohua YIN, et al. (殷伯华，中国科学院电工研究所)(China)····· [3-0041]
- ✓ Subaperture stitching test of a cylindrical mirror with large aperture, Shuai XUE, et al. (薛帅，国防科学技术大学)(China) ····· [3-0045]
- ✓ A Novel Way of Squareness Measurement on Ultra Precision Motion Stage Basing on the Error Separation, Tao LAI, et al. (赖涛，国防科学技术大学)(China) ····· [3-0052]
- ✓ Stochastic dual-plane digital holography using Mach–Zehnder interferometer, Fengpeng WANG, et al. (王凤鹏，北京工业大学数理学院)(China)····· [3-0055]

13:00-17:00 April 27 ····· SESSION 3-2
HEHE HALL 和合厅(10 min / report)

Session chair: ZHANG Rongzhu(张蓉竹), SICHUAN University

- ✓ Three Dimensional Measurement of Multilayer Thin Films Based on Scanning White Light Interferometer, Zhendong SHI, et al. (石振东，中物院八所)(China) ····· [3-0057]
- ✓ Error Source in High Precision Shack-Hartmann Wavefront Sensor, Zengxiong LU, et al. (卢增雄，中国科学院光电研究院)(China) ····· [3-0060]
- ✓ Design of a compound eye system with planar micolens array and curved folded mirrors, Mengchao MA, et al. (马孟超，合肥工业大学)(China) ····· [3-0061]
- ✓ Mounting of reference surface for a transmission sphere, Wei-Jei Peng, et al. (Wei-Jei Peng, Instrument Technology Research Center)(Taiwan, China) ····· [3-0063]
- ✓ Sub-nanometer asphere fabrication and testing, Erlong MIAO, et al. (苗二龙，长春光机所)(China) ····· [3-0067]
- ✓ Fabrication error analysis of the CGHs for aspheric surface measurement , Zhiyu ZHANG, et al. (张志宇，中科院长春光机所)(China) ····· [3-0069]

Tea Time

- ✓ Factors Affecting the Measurement of Photochromic Lens Performance, Yangzuo OU, et al. (欧阳鎏，卡尔蔡司光学（中国）)(China) ····· [3-0078]
- ✓ 3D Shape Reconstruction of Rail and surface defect detection Based on PMP, Fan DUAN, et al. (段帆，西南交通大学)(China) ····· [3-0082]
- ✓ PMP based on virtual reference plane used in rail shape measurement, Hongbing REN, et al. (任宏兵，西南交通大学)(China) ····· [3-0091]
- ✓ Rapid matching of stereo vision based on fringe projection profilometry, Ruihua ZHANG, et al. (张瑞华，南通职业大学)(China) ····· [3-0104]
- ✓ Gaussian Process Based Intelligent Sampling for Measuring Nano-structured Surfaces with Scanning Probe Microscopy, Lijian SUN, et al. (孙立剑，上海交通大学)(China) ····· [3-0107]
- ✓ Measurement of GMAW Weld Pool by the Reflected Laser Lines, Zhenzhou WANG, et al. (王振洲，中科院沈自所)(China) ····· [3-0108]
- ✓ A Review of Relationship between Optical Performance and Geometrical Errors of Freeform Optics, Panyu ZHOU, et al. (周攀宇，复旦大学)(China) ····· [3-0113]

8:30-12:00 April 28 ····· SESSION 3-3
HEHE HALL 和合厅(10 min / report)

Session chair: Hongwei JING (景洪伟),IOE

- ✓ Monitoring PMD in two-dimensional phase diagram for NRZ-DPSK systems using 0.25 bit period delay-tap sampling technique, Xichan Zhang, et al. (Xichan Zhang, University of Science and Technology Beijing)(China) ····· [3-0121]
- ✓ An anti-occlusion method for object tracking based on adaptive particle filter, Xianhui HE, et al. (贺先辉, 中科院光电技术研究所)(China) ····· [3-0131]
- ✓ Aspheric optical surface testing based on on-axis Hartmann test in reverse method with different fringe modes of illumination, Zuozuo XIA, et al. (夏峥铮, 北京理工大学)(China) ····· [3-0134]
- ✓ Study on the metrological performance of self-calibration angle encoder, Yao HUANG, et al. (黄垚, 中国计量科学研究院)(China)····· [3-0140]
- ✓ A New Method of Measuring Angular Position Error of Based on Laser Collimation, Yangyang CAI, et al. (蔡杨杨, 北京交通大学理学院)(China) ····· [3-0141]
- ✓ An improved self-calibration algorithm for Multilateration coordinates measuring system, Dongjing ZUO, et al. (缪东晶, 中国计量科学研究院)(China) ····· [3-0144]
- ✓ High resolution aspheric surface measurement technology based on laser interferometer, Xiaofei DIAO, et al. (刁晓飞, 中国计量科学研究院)(China)····· [3-0149]

Tea Time

- ✓ Optimization design of ultra-low vibration sensitivity fiber spools for laser stabilization, Guanjun XU, et al. (许冠军, 中科院国家授时中心)(China) ····· [3-0151]
- ✓ Development of Nano-LTP Measurement at SSRF, Yumei HE, et al. (何玉梅, 上海应用物理研究所)(China) ····· [3-0164]
- ✓ Error Analysis and Experimental Verification of All Fiber Displacement Interferometer System, Xincai ZHAO, et al. (赵新才, 中物院一所)(China) ····· [3-0171]
- ✓ Modeling and Simulation of Atmosphere Interference Signal Based on FTIR Spectroscopy Technique, Yugui ZHANG, et al. (张玉贵, 北京空间机电研究所)(China)[3-0173]
- ✓ Distributed pavement subgrade shape monitoring based on FBG sensing technique, Zhiguo CHEN, et al. (陈志国, 吉林省交通运输研究所)(China)····· [3-0180]
- ✓ Study on High-Precision Measurement of Long Radius of Curvature, Dongcheng WU, et al. (武东城, 长春光机所)(China) ····· [3-0186]
- ✓ Ultra-high accuracy Point Diffraction Interferometer: development, accuracy evaluation and application, Jie YU, et al. (于杰, 中科院长春光机所)(China) ····· [3-0187]

Conference 4: Design, Manufacturing and Testing of Micro and Nano Optical Devices and Systems

Conference Chairs:

Tianchun YE(叶甜春), Director of Institute of Microelectronics, C A Science
Tingwen XIN(邢廷文), Institute of Optics and Electronics(IOE), CAS (China)
Song HU(胡松), Institute of Optics and Electronics (IOE), CAS (China)

8:30-12:00 April 27 ····· SESSION 4-1
Multi-fuctional HALL 多功能厅 (20 min/report)

Session chair: XIN Tingwen(邢廷文), IOE

- ✓ Optical design of microlens array for CMOS image sensors, Rongzhu ZHANG, et al. (张蓉竹, 四川大学电子信息学院)(China) ····· [4-0011]
- ✓ Design and fabrication of polymer-based multimode interference optical splitters, Yuzuo LIANG, et al. (梁宇鑫, 大连理工大学)(China) ····· [4-0021]
- ✓ Analysis and amelioration about the cross-sensitivity of a high resolution MOEMS accelerometer based on diffraction grating, Qianbo LU, et al. (卢乾波, 浙江大学)(China) ····· [4-0022]

Tea Time

- ✓ Topography measurement of micro structure by modulation-based method, Yi ZHOU, et al. (周毅, 中科院光电技术研究所)(China) ····· [4-0023]
- ✓ Thickness measurement of transparent film by white-light interferometry, Qinyuan DENG, et al. (邓钦元, 光电技术研究所)(China) ····· [4-0024]
- ✓ Aspherical diffraction lens design and wavefront testing, Lihua WANG, et al. (汪利华, 中科院光电所)(China) ····· [4-0026]

13:00-17:00 April 27 ····· SESSION 4-2
Multi-fuctional HALL 多功能厅 (20 min/report)

Session chair: Wumei LIN(林妩媚), IOE

- ✓ Optical design of a scalable imaging system with compact configuration and high fidelity, Zuoqun JI, et al. (季轶群, 苏州大学光电学院)(China) ····· [4-0032]
- ✓ A low radiation optical system with lens positioned inside of the infrared detector Dewar, Jun ZHOU, et al. (周军, 北京遥感设备研究所)(China) ····· [4-0034]
- ✓ Study on evaluation method about the form error of micro lens array for illumination, Zhijie LIAO, et al. (廖志杰, 中科院光电技术研究所)(China) ····· [4-0039]

Tea Time

- ✓ Silicon-Based Metalens with Zero Refractive Index, Xintao HE, et al. (何辛涛, 中山大学物理学院)(China) ····· [4-0040]
- ✓ Three-dimensional profile measurement of pyramid micro-structure array , Yao HU, et al. (胡摇, 北京理工大学)(China) ····· [4-0042]
- ✓ The effect of structural coefficient on stiffness and deformation of hydrostatic guideway, Zhifeng LAI, et al. (赖志锋, 哈尔滨工业大学)(China) ····· [4-0048]

Conference 5: Opto Electronics Material and Devices for Sensing and Imaging

Conference Chairs:

Yadong JIANG(蒋亚东), Dean of School of Optoelectronic Information, University of Electronic Science and Technology of China

Bernard Kippelen, Vice Director, Center of Organic Photonics and Electronics, Georgia Institute of Technology (USA)

Junsheng YU(于军胜), State Key Laboratory of Electronic Thin Films and Integrated devices

8:30-12:00 April 27 ····· SESSION 5-1
FULE HALL 福乐厅 (15 min/report)

Session chair: 周殿力, 电子科技大学光电信息学院, UESTC

- ✓ Imaging Technique based on multi-linear array integrated TDICCD, Qiang LI, et al. (李强, 北京空间机电研究所)(China) ····· [5-0002]
- ✓ Thz transmittance and electrical properties of silicon doped vanadium dioxide films tuning by annealing temperature, Xuefei WU, et al. (吴雪飞, 电子科技大学)(China)[5-0008]
- ✓ Research of timing design and adjusting methods of EMCCD, Peng WANG, et al. (王鹏, 北京空间机电研究所)(China) ····· [5-0009]
- ✓ A Deformable Plane-parallel Optical Plate with 16 Actuated Points for Low Order Aberrations Correction, Min ZHANG, et al. (张敏, 长春光机所)(China) ····· [5-0013]
- ✓ Optimal Design Method of Static Simulation for Unimorph DM, Zhanbin FAN, et al. (范占斌, 国防科技大学)(China) ····· [5-0017]

Tea Time

- ✓ Ultra-low power anti-crosstalk collision avoidance LIDAR using CPPM approach, Jie HAO, et al. (郝杰, 清华大学)(China) ····· [5-0024]
- ✓ Fabrication and characterization of wafer-scaled high-aspect-ratio SiO2 patterned Si substrate through stepper lithography and lift-off process for III-V heteroepitaxy, Yongle Qi, et al. (Yongle Qi, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Science)(China) ····· [5-0042]
- ✓ Fabrication and characterization of wafer-scaled high-aspect-ratio SiO2 patterned Si substrate through stepper lithography and lift-off process for III-V heteroepitaxy, Yongle QI, et al. (戚永乐, 中科院苏州纳米所)(China) ····· [5-0043]
- ✓ Investigation on the acceptor state of Li-N codoped ZnO films, Bingzuo ZHANG, et al. (张炳烨, 大连理工大学)(China) ····· [5-0046]
- ✓ High performance organic optoelectronic integrated device based on triplet-triplet annihilation materials with a interlaid architecture, Dianli ZHOU, et al. (周殿力, 电子科技大学)(China) ····· [5-0058]

13:00-17:00 April 27 ····· SESSION 5-2
FULE HALL 福乐厅 (15 min/report)

Session chair: 邢坤, 电子科技大学光电信息学院, UESTC

- ✓ Study of Pixel Circuit of Direct Injection Readout Circuit for IRFPA, GUAN Yu, et al. (GUAN Yu, Luoyang Optoelectro Technology Development Center)(China)··· [5-0061]
- ✓ A research on high-speed and large-capacity interface technology basing on fiber channel, Zhiqiang ZHAO, et al. (赵志强, 中科院光电技术研究所)(China) ····· [5-0064]
- ✓ an biosensor platform based on Raman spectroscopy of porous silicon, Jiaqing MO, et al. (莫家庆, 新疆大学)(China) ····· [5-0066]
- ✓ Simulation of GaN/InGaN avalanche phototransistors, Zhongliang ZHOU, et al. (周中良, 苏州大学)(China)····· [5-0068]
- ✓ PSPICE simulation of transient characteristics of GaN based MSM structure UV detector grown by MBE, Xiangming GAO, et al. (高向明, 重庆师范大学)(China)[5-0075]
- ✓ Polymer solar cells with NiO thin films as positive electrode cells processed by spray pyrolysis in a low substrate temperature, Zuo WANG, et al. (王祺, 重庆文理学院)(China) ····· [5-0076]

Tea Time

- ✓ Waveguide Effect of Fe Doped GaN Alloy Grown by MOCVD, Xiangming GAO, et al. (高向明, 重庆师范大学)(China) ····· [5-0077]
- ✓ Facile Solution Processed MoO3 Thin Film as Hole Transportation Layer for Polymer Solar Cells, Chengxi Zhang, et al. (Chengxi Zhang, 重庆文理学院)(China)····· [5-0080]
- ✓ Solution prepared fexible OLED device with high light extraction performance, Zuo LI, et al. (李璐, 重庆文理学院)(China) ····· [5-0083]
- ✓ ANALYSIS OF CRACK FRACTURE MECHANISM DUE TO SEQUENTIAL INDENTATION TESTS ON SAPPHIRE, Ningchang WANG, et al. (王宁昌, 华侨大学)(China)····· [5-0085]
- ✓ The ambipolar Operation of Lateral and Vertical PbSe Quantum dots Field Effect phototransistors, Haiting Zhang, et al. (张海婷, 天津大学)(China) ····· [5-0086]

Conference 6: Smart Structure and Materials for Manufacturing and Testing

Conference Chairs:
Xiangang LUO(罗先刚), Institute of Optics and Electronics, CAS (China)
Minghui HONG, National University of Singapore (Singapore)
Min GU, professor at Swinburne University of Technology (Australia)

8:30-12:00 April 27 ····· SESSION 6-1
PINGJIANG HALL 平江厅 (20 min / report)

Session chair: Xiangang LUO(罗先刚), IOE

- ✓ A high-damping-performance magnetorheological material for passive or active vibration control, Taixiang LIU, et al. (刘太祥, 激光聚变研究中心)(China) ····· [6-0001]
- ✓ A Self-Deployable Structure Designed for Space Telescope for Microsatellite Application, Chao ZHAO, et al. (赵超, 中物院总体工程研究所)(China) ····· [6-0004]
- ✓ Detection of load application onto an optical fiber through changes in speckle patterns in an output light spot, Makoto Hasegawa, et al. (Makoto Hasegawa, Chitose Institute of Science and Technology)(Japan)····· [6-0005]

Tea Time

- ✓ The design and manufacture of ultrathin dual-band absorber based on metamaterial, Yong ZHANG, et al. (张勇, 中北大学)(China) ····· [6-0006]
- ✓ Humidity sensor base on the ZnO nanorods and fiber interferometer, Jian WANG, et al. (王健, 安徽大学)(China) ····· [6-0009]
- ✓ Lasing in nano-grating with Fano resonance, Yabin CHEN, et al. (陈亚彬, 中山大学物理学院)(China)····· [6-0010]

Conference 7: Sub- nanometer accuracy measurement for synchrotron optics and X-ray optics

Conference Chairs:

Shinan QIAN(钱石南), Brookhaven National Laboratory (USA)
Mourad Idir, Brookhaven National Laboratory (USA)
Daniele Cocco, SLAC National Accelerator Laboratory (USA)
Tiqiao XIAO, Shanghai Synchrotron Radiation Facility (China)
Kazuto Yamauchi, University of Osaka (Japan)

Participating Institute:

Institute of High Energy Physics (China)
Shanghai Synchrotron Radiation Facility (China)
Brookhaven National Laboratory, National Synchrotron Light source II (USA)
SLAC National Accelerator Laboratory (USA)
Advanced Light Source, Lawrence Berkeley National Laboratory (USA)
Advanced Photon Source, Argonne National Laboratory (USA)
Imagine Optic (France)
HZB - BESSY-II (Germany)
Physikalisch-Technische Bundesanstalt (Germany)
JTEC Corporation (Japan)
National Institute of Advanced Industrial Science and Technology (Japan)
University of Tokyo (Japan)
Japan Synchrotron Radiation Research (Japan)
University of Osaka (Japan)
SPRING8/ JASRI Light Source and Optics Division (Japan)
ALBA Synchrotron (Spain)
National Synchrotron Radiation Research Center (Taiwan)
Diamond Light Source (UK)

8:30-10:10 April 27 ····· SESSION 7-1
Nano-Metrology Facility and Requirements (20 min / report)

Session chair: Daniele Cocco (SLAC)

- ✓ Welcome: Mourad Idir (BNL) 5 min.
- ✓ Nano-Metrology at Diamond Light Source, Kawal Sawhney, et al. (Kawal Sawhney, Diamond Light Source)(UK) ····· *(Invited)* [7-0030]
- ✓ The NSLSII Optical Metrology Laboratory , mourad didir, et al. (mourad didir, BNL-NSLSII)(USA) ····· [7-0022]
- ✓ The new BESSY-II Optics Laboratory - a Facility for Measuring X-Ray Optics of sub-50nrad Precision, Frank Siewert, et al. (Frank Siewert, Helmholtz Zentrum Berlin)(Germany) ····· *(Invited)* [7-0011]
- ✓ Development of optical metrology at SSRF, (Wang Jie / SSRF) ····· *(Invited)*

Tea Time

10:30-11:45 April 27 ····· SESSION 7-1
Nano-Metrology Facility and Requirements (20 min/report)

Session chair: Kawal Sawhney (DIAMOND)

- ✓ Metrology for x‐ray optics: current capabilities, new challenges, and tasks for further developments , Valeriy V. Yashchuk, et al. (Valeriy V. Yashchuk, Lawrence Berkeley National Laboratory)(USA) ····· *(Invited)* [7-0024]
- ✓ How to specify super-smooth mirrors: simulation studies on nano-focusing and wavefront preserving X-ray mirrors for next-generation light sources, Xianbo Shi, et al. (Xianbo Shi, Argonne National Laboratory)(USA) ····· [7-0002]
- ✓ Metrology-assisted mirror development at SLAC, Daniele Cocco, et al. (Daniele Cocco, SLAC National Accelerator Laboratory)(USA) ····· [7-0027]

Lunch Time

13:30-14:30 April 27 ····· SESSION 7-2
Nano-Accuracy Profiler (20 min/report)

Session chair: Mourad Idir (BNL)

- ✓ Comparison of small-angle deflectometric measurements with different apertures down to the sub-millimetre range, Gerd Ehret, et al. (Gerd Ehret, Physikalisch-Technische Bundesanstalt)(Germany) ····· *(Invited)* [7-0010]
- ✓ Innovative Nanoaccuracy Surface Profiler for sub-50 nrad rms mirror test, Shinan Qian, et al. (Shinan Qian, Brookhaven National Laboratory)(USA) ····· [7-0004]
- ✓ Progress of upgraded long trace profiler at NSRRC, Duan-Jen Wang, et al. (Duan-Jen Wang, NSRRC)(Taiwan, China) ····· [7-0005]
- ✓ Development of slope sensor for long trace profiler, Yasunori Senba, et al. (Yasunori Senba, JASRI)(Japan) ····· *(Invited)* [7-0017]

Tea Time

15:00-16:45 April 27 ····· SESSION 7-2
Nano-Accuracy Profiler (20 min/report)

Session chair: Josep Nicolas (ALBA)

- ✓ Optical Metrology at BSRF, Ming LI, et al. (李明, 中科院高能物理研究所)(China) ····· *(Invited)* |
- ✓ Development of non-contact 3D nanoprofiler using normal vector tracing, Takao Kitayama, et al. (Takao Kitayama, Osaka University)(Japan) ····· [7-0018]
- ✓ SHARPeR : a state of the art mirror metrology platform, rafael mayer, et al. (rafael mayer, Imagine Optic)(France) ····· [7-0028]
- ✓ Spatial resolution enhanced surface slope metrology based on wavefront coding method, Fugui YANG, et al. (杨福桂, 中科院高能物理研究所)(China) ····· [7-0015]
- ✓ Evaluation of figure accuracy of Wolter mirror fabricated by electroforming, Satoru Egawa, et al. (Satoru Egawa, the University of Tokyo)(Japan) ····· [7-0014]

8:30-10:15 April 28 ····· SESSION 7-3
In Situ Metrology– Adaptive Optics (20 min/report)

Session chair: Tiqiao Xiao (SSRF)

- ✓ Spring correctors for nanometer figure correction of x-ray mirrors, Josep Nicolas, et al. (Josep Nicolas, ALBA synchrotron light source)(Spain) ····· *(Invited)* [7-0023]
- ✓ Speckle based in-situ metrology of X-ray optics at Diamond Light Source, Hongchang Wang, et al. (Hongchang Wang, Diamond Light Source)(UK) ····· [7-0003]
- ✓ Measurement of shape errors on an imaging mirror using an X-ray grating interferometer, Satoshi Matsuyama, et al. (Satoshi Matsuyama, Osaka University)(Japan) ····· [7-0009]
- ✓ In-situ slope error measurement for adaptive hard x-ray focusing optics, Takumi Goto, et al. (Takumi Goto, Osaka University)(Japan) ····· [7-0012]
- ✓ New Scheme to Control X-ray Deformable Mirrors, Lei HUANG, et al. (Lei HUANG, Brookhaven National Laboratory)(USA) ····· [7-0013]

Tea Time

10:45-12:05 April 28 ····· SESSION 7-3
Mirror Fabrication – Metrology (20 min/report)

Session chair: Kazuto Yamauchi (U. Osaka)

- ✓ Fabrication of OSAKA MIRROR for Synchrotron Application, Akihiko Ueda, et al. (Akihiko Ueda, JTEC Corporation)(Japan) ····· [7-0025]
- ✓ λ/100 reference flat for commercially available Fizeau interferometer, Yohan Kondo, et al. (Yohan Kondo, National Institute of Advanced Industrial Science and Technology (AIST))(Japan) ····· [7-0026]
- ✓ Compensation in testing Mid-spatial-Frequency Errors of aspheric surface using White light interferometer, Dongqi SU, et al. (苏东奇，长春光机所)(China) ····· [7-0006]
- ✓ Measurement of power spectral density in middle spatial frequency range of optical surfaces with high accuracy by optical profiler, Xudong XU, et al. (徐旭东，同济大学)(China) ····· [7-0020]
- ✓ Control of lateral thickness gradients of EUV/Soft x-ray multilayer on curved substrates , Bo YU, et al. (喻波，长春光机所)(China) ····· [7-0031]

WORKSHOP: Innovation in Emerging Photon Industry(光学制造智能化创新)

Conference Chairs:
Lingbao Kong(孔令豹), FuDan University
Fan WU(伍凡), IOE. CAS
QiMing XIN(辛企明), BeiJing Institute of Technology

9:00-12:00 April 28 Workshop FULE HALL of BUILDING 8
FULE HALL (8 号楼 3 楼 福乐厅)

Session chair: Lingbao Kong(孔令豹), QiMing XIN(辛企明)

- ✓ **OPTurn Company Ltd** 北京欧唐科技发展有限公司 **9:00-10:00**
- ✓ 法国 **SAGEM** 公司 **10:00-11:00**
- ✓ 奥普泰克亚洲有限公司 **11:00-12:00**

AOMATT China 2016 Organizing Committee • Tel/Fax +86 028 85100583
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同心多元化发展
---浙江水晶光电新型显示业务

浙江水晶光电科技股份有限公司，是国家级高新技术企业，成立于 2002 年 8 月 2 日，2006 年 12 月 21 日整体变更为股份有限公司，2008 年 9 月 19 日在深圳交易所挂牌上市（股票代码 002273）。公司所处行业属于光学光电子行业，并位于光学光电子产业链上游，是国内专业从事精密薄膜光学及延伸产品研发、生产和销售的知名光电元器件制造企业。公司目前主导产品为用于数码相机、可拍照手机摄像头等数字摄像头镜头系统的光学低通滤波器，红外截止滤光片；用于 LED 照明领域的蓝宝石衬底及 PSS 衬底；用于可穿戴消费类电子产品的蓝宝石光学应用产品；用于安全防护类产品的反光材料，用于虚拟显示类产品的投影部件。

以虚拟显示类产品为主的新型显示板块， 成立于 2009 年。 经过 7 年的发展， 新型显示板块已经孵化完成以车载 HUD、无屏超短焦投影及智能眼镜为产品导向的三大发展方向。

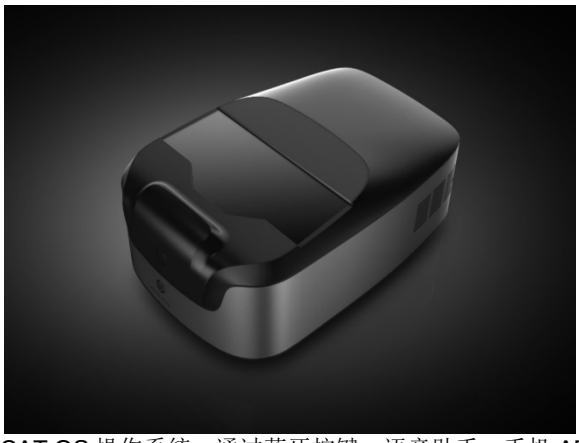
超短焦：

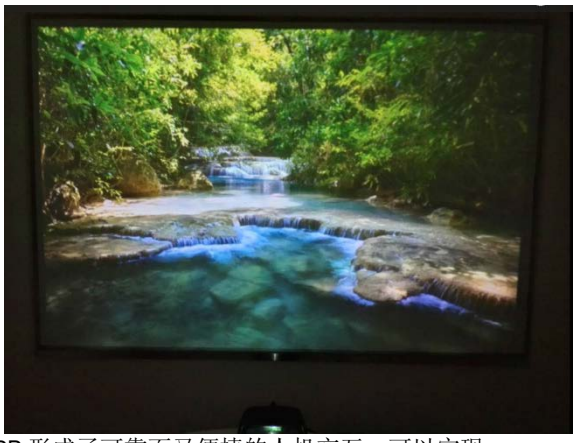
水晶光电超短焦项目，主要开发 DLP 投影产品，涵盖 LED 和激光无屏电视，智能投影光引擎。超短焦投影，是投影领域里面的一个技术高峰。在数年前，一直被日本及欧洲公司垄断，国内处于技术空白。水晶光电从 13 年开始研发超短焦投影技术，通过 2 位博士、数位硕士的努力，经过两年的艰苦历程，终于在 15 年 9 月于深圳香格里拉酒店发布 E100 超短焦投影光引擎。

E100 是一款使用 LED 光源的超短焦投影光引擎，显示芯片为 DLP，分辨率 1280×800，在投影距离 0.6m 上可投 100 英寸的画面。可以广泛使用于家庭电视或者家庭影院等，以满足人们对超大屏幕的视觉享受的需求。

HUD 车载抬头显示

水晶光电 Qrios HUD 的设计理念是利用平视显示器实现汽车现实增强显示，为用户提供兼具安全驾驶和移动车生活享受的解决方案。Qrios HUD 可以安装在汽车仪表台上方，运行水晶光电自主开发的





CAT OS 操作系统，通过蓝牙按键、语音助手、手机 APP 形成了可靠而又便捷的人机交互，可以实现电话接听、短信查看。

小而美、少而精的设计原则

在外观上，Qrios HUD 机身呈流线型设计，加入了无断点金属中框、呼吸灯、电机自动开合等一系列科技元素，使产品非常具有品质感和科技感。产品参考了主流车身颜色设计，有钛银灰、珍珠白、经典红 3 种颜色，可以与汽车完美融合。Qrios 团队在配件上同样花了不少心思：特殊设计的可充电底座，可以适配更多车型；全金属车充，双口 USB，可同时给 iPad 和 iPhone 充电；蓝牙按键，金属外壳，硅胶纽带，待机时间超过一年。

可靠流畅的硬件方案

在硬件主控方案上，Qrios HUD 采用了与前装车机标准接轨的 Freescalei.M.X 6 平台，四核 1G Hz。在光学显示上，采用了水晶光电自主研发设计的 DLP 投影平视显示光学系统，在保障与高端车型前装主流平视显示同样 2.2 米的投影距离下，显示面积提升了 2.33 倍，分辨率提升了 1.66 倍，而功耗下降了 9 倍，以现实增强显示提升了驾驶体验。产品内置了亮度传感器，虚拟图像亮度会随着环境光的

变化自动改变，方便人眼适应进出车库或隧道等场景的亮度剧烈变化。Qrios HUD 一个比较出彩的地方是温控设计，除了使用直流离心高压侧吹式风机，还使用了在军用探测器上常用的半导体制冷技术，从而彻底解决了 DLP 芯片受环境温度的困扰。

CAT OS：汽车现实增强显示

CAT OS 是今天发布会的一大亮点，全称是 Crystal Auto Operation System，是一款基于 Android 系统深度定制的汽车现实增强显示系统。与传统 OS 显示在实体屏幕的区别在于，CAT OS 是显示虚拟显示的屏幕上，需要与道路实景完美的融合。“简洁、明了”成了这个系统的最大风格，色块、线条的运用远多于文本，对用户开车的分心影响是几乎是没有的。CAT OS 与主流车机一样，主要有四大功能：导航，离线+在线结合的方式平衡了流量与地图更新的烦恼；互联网电台，在哪里都可以听到自己想听的节目；语音助手，最便捷自如的操作；电话短信，尤其手机消息（QQ、微信、短信）转接大提升了用户开车时的体验。

极致便捷的交互体验

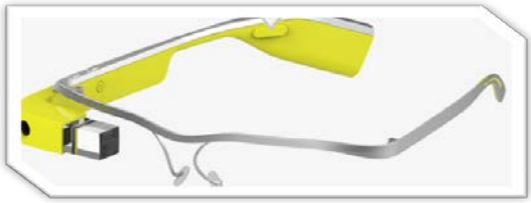
Qrios 目前采用的交互方式是蓝牙按键、语音和手机 App 三种。开车是能给人很强的快感的，但也存在着潜在危险，所以一个可靠的动动手指就能轻松完成操作的蓝牙按键是必不可少的。智能语音方案提供商云知声提供了误识别率（<5%）的语音交互体验，采用双麦降噪技术，可以用语音操作几乎 HUD 的所有功能。Qrios 的手机 APP，实现了手机端对设备的所有控制，在有 WIFI 的环境下可以下载缓存音乐、固件等，上车时手机 APP 将自动把数据同步到 Qrios HUD。

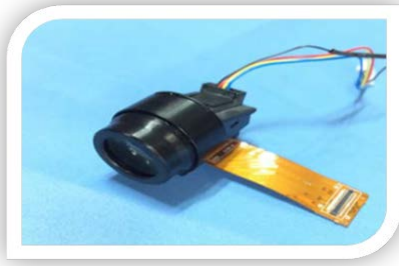
智能近眼显示

水晶光电近眼显示板块围绕 AR/VR 产业化布局不断开发， 结合光学模块技术优势，围绕 AR 市场及 VR 技术发展方向布局新产品。

AR 小棱镜，大世界

折返式光学显示模组透过小小的棱镜，世界尽在你眼中 。800×480 高分辨率宽屏显示最佳光学影像。8 度斜视效果技符合人体工学原理。无障碍感，超轻重量
环境吸收镀膜技术 兼容各种使用场景





VR 眼镜光学模组

最逼真的绚丽色彩 单目大视场角超高分辨率，清晰度可达 3147PPI，画质丝毫毕现 ，更广色域，展示真实的自然色彩 ，高对比度，展现暗夜场景的无损还原 ，实现 500 度调节，摆脱眼镜束缚 。光影科技小于 12 毫秒低延迟 无眩晕感绝妙体验
小体积，大视野 。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第十二届国际激光加工技术研讨会（LPC 2017）
第四届中国激光市场高峰论坛
光学前沿：第十二届全国激光技术与光电子学学术会议
2017“现代光学制造工程与科学”（上海）国际论坛
中国（上海）国际机器视觉技术及工业应用研讨会
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德国全欧光学（TRIOPTICS GmbH）成立于1991年，总部位于德国汉堡，二十多年来一直致力于全自动、高精度光学检测仪器的研究、开发和生产，其产品在全球范围内的光学相关企业和科研院所都得到了广泛应用，许多产品的测试结果已成为公认的业界标准。

北京全欧光学检测仪器有限公司（TRIOPTICS CHINA）系德国全欧光学在中国的分公司，成立于2005年，总部位于北京，在上海、成都、深圳设有办事处。北京全欧光学负责TRIOPTICS品牌及其旗下子公司全部产品在中国的销售及技术支持，包括安装、培训及售后服务等。

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- OptiCentric® 中心偏差测量仪
- OptiCentric® DUAL 双光路中心偏差测量仪
- OptiCentric® IR 红外中心偏差测量仪
- OptiCentric® MAX 大口径定心仪
- OptiCentric® Bonding 光学镜头定心装调系统
- OptiCentric® Cementing 光学镜片定心胶合系统
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- OptiCentric® 3D 镜面间隔及中心偏差测量仪
- ATS 全自动数控定心车床
- ImageMaster® Universal 研发型MTF测量仪
- ImageMaster® HR 紧凑型MTF测量仪
- ImageMaster® HR IR 紧凑型红外MTF测量仪
- ImageMaster® Compact 紧凑型卧式MTF测量仪
- ImageMaster® PRO 工业型MTF测量仪
- SortMaster® 全自动分料机
- ProCam® Test 相机模组光学参数测量仪
- ProCam® 相机模组检测装调系统
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- SpectroMaster® 高精度折射率测量仪
- TriAngle® 电子自准直仪
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- D-275-AAT-WW 全自动内调焦装调望远镜
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- IOL Tester®人工晶状体IOL光学参数测量仪
- Optoliner® CCD相机性能参数测量系统
- AspheroMaster® 非球面与自由曲面轮廓仪

OPTURN 欧唐科技

公司简介

北京欧唐科技发展有限公司（欧唐科技），成立于2007年，致力于光学精密制造与检测领域，欧唐科技有着几十年的光学领域研发经验，与业内经验丰富的专家保持良好的合作关系，可以为相关领域提供技术咨询服务。我们不仅代理世界一流仪器设备与软件，同时也应客户的需求，研发定制仪器与装置。公司主要工作于以下领域：

>> 光学材料测试　>> 光学加工(设备和辅料)　>> 光学元件检测
>>光学系统装调　>> 光学表面清洁和保护　>>光学薄膜

● 检测类

干涉仪

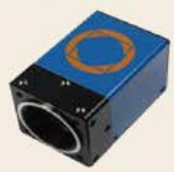
4D Technology

高精度菲索干涉仪、动态相移干涉仪、动态光学轮廓仪、同步偏振相机。用于光学波前测量，尤其擅长对振动环境下的光学元件、系统的波前的精密测量，以及大口径表面的粗糙度测量。

夏克－哈特曼波前探测器

OPTOCRAFT

动态范围大，可测倾斜量超过 +/- 10 度，可测曲率半径 >10mm；软件分析功能强大，主要用于光学系统的辅助装调、激光光束的波前诊断。适用波长范围：DUV-UV-VIS-SWIR



光热式弱吸收测试仪

SPTS

采用点衍射干涉原理测量元件对激光的极低热吸收，测量分辨率可达 0.01ppm。这是一种相对测量的方法，应用于薄膜面吸收或材料体吸收的测量，也可用于对镀膜过程微变化的间接监控。

应力双折射测试仪

ilis

通用型可以高精密测量光学玻璃材料的应力双折射，精度可达 0.01nm；对大尺寸元件，可以进行拼接测量。实时型可以在线检测玻璃材料的残余应力、监测装配过程中的装夹应力变化，也可以用于镜头胶合的应力测量。

OTS Optics Test Station 多功能光学测量工作站

OEG

光学测量工作站OTS系列，是OEG公司为光学行业而设计开发的，用于检测透镜、镜头或其他光学元件参数，计算机控制，多功能的测量仪器。

OTS系列产品的标准型号有：

OTS200 / OTS500

其主要功能如下：

- 有效焦距 (EFL)
- 后焦距 (BFL)
- 曲率半径 (R)
- 法兰焦距 (FFL)
- 调制传递函数 (MTF)
- 中心偏差
- 偏角、楔角

Fogale 镜面定位仪

FOGALE nanotech

非接触测量镜头中心厚、镜头系统内部的镜间隔，适用于光学镜面的间隔控制、玻璃材料实际折射率测量等。测量精度 1um 或 0.2um。

薄膜类

离子束与等离子体技术与设备

基于在离子束与等离子体源设计与制造技术上的成就，结合多年积累的真空运动控制经验，可以提供离子束（IBS）镀膜机、磁控（MS）溅射镀膜机、离子束刻蚀（IBE）机以及离子束加工（IBT）设备。另外，也可提供各种圆形、长条形离子源或等离子体源。

薄膜设计软件

当前最具活力的光学薄膜设计与反演分析软件，其作者是著名的针式算法的发明人。针对镀膜过程的不同应用，采用三套独立算法，进行薄膜设计、镀膜材料光学参数的测定、镀膜后膜系的反演分析；计算速度快，分析精准。

全自动量热式弱吸收测试仪

德国汉诺威激光中心研发，是一种对热吸收进行绝对测量的仪器。由泵浦激光对样品照射，采用高精度热电偶对受热区域进行温度测量，从而获得样品对该波长的激光的绝对吸收信息，精度可达 <1ppm。

表面清洁保护剂

一种高分子溶液，刷涂或喷涂在表面后，形成一层膜，对表面起到保护作用；揭掉后可以去除手印、水印和灰尘等表面污染物，而不会在表面留下任何分子级的残留。应用于高能激光镜、CCD、光栅、晶体、光学系统的表面清洁、防护与维护。

薄膜型光学器件

定制的薄膜型光学元件，厚度仅数微米。可以应用于激光分束、衰减、滤波等，适用波长涵盖 UV 到 IR。

超精加工类

超声波车削系统

德国 son-x 公司最新推出了新一代超声波车削系统 。这一创新产品将金刚石加工技术推到了一个新的水平，可以直接对硬化钢合金、钛合金、镍合金及玻璃等材料进行超精密金刚石车削加工。其振动频率达到 100kHz，且没有加工尺寸限制。

金刚石刀具

来自英国，采用天然金刚石作为切削刃，是目前市场上用户最多的金刚石刀具品牌。我公司提供刀具的返厂修磨服务。原厂修磨采用与制造相同的工艺标准，可以最大程度地降低刃磨对钻石的损耗，延长刀具钻石的使用寿命。

DiffSys 超精密金刚石车削软件

软件已成为现代光学加工中应用范围最广、使用频率最高、计算结果最好的市场领导者。除了可以设计简单的元件加工外形以外，还能够针对非球面、衍射光学元件、离轴非球面、环面、自由曲面等复杂曲面进行 2D&3D 的设计、测量以及校正，并支持 CAD 数据导入等。

瑞士高等级钻石粉

用于超精密抛光的精细金刚石微粉，粒度范围 0 ∽ 12um，亦可提供钻石抛光液。质量稳定，切削效率高，且不易破碎，可以保证微粉粒度与研磨粗糙度的稳定对应关系。

Sagem REOSC Talk Topics：Freeform optics for space and laser

As the leader optics and mechanics designer manufacturer player, Sagem REOSC focus on Astronomy, space, lithography and high energy industry.

Talker：Mr. Roland GEYL， The VP of Sagem REOSC,

Abstract : Freeform optics are a game changer that can have positive impact on space payloads. We will present in our talk some theoretical work done demonstrating the nice potential of this type of designs.

In the same way, high energy laser need new advanced focusing solutions in order to perform best science with the intense laser beam produced. The manufacturing of an extreme freeform off axis parabola recently produced at REOSC will be presented.

工业 4.0 智能机器人光学加工系统解决方案----法国 SAGEM

研磨-抛光-精修一站式系统解决方案

适用面型：平面、球面、非球面、自由曲面

适用外形：适用各种不规格外形

适用材料：玻璃、微晶、石英、SiC、铍等各种材料

生产效率：收敛效率 25%~70% /每个循环

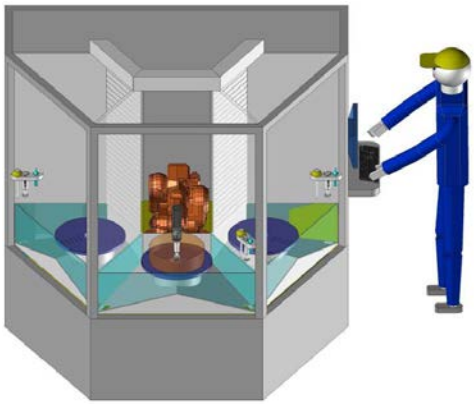
举例：中小机器人：300mm 非球面，输入精度 150um，输出精度 λ/30 RMS，
25 小时加工完成

方案包含内容：含全套硬件、软件、法国原厂两周现场培训、考核；
国内安装调试、国内 2 周培训、考核

包教包会

中小机器人（适用口径 30~400mm）或（300~700mm）

大机器人（适用口径 600~2000mm）超大机器人（适用口径 2000~4000mm）



联系：Sagem REOSC 中国代表吴柏林 Tel: 18918185850 mail: anderson.wu@oeengine.cn

Advanced Wheel Polishing Technology (A-WPT)

Active Fluid Jet Polishing (A-FJP)

Classic Pitch Polishing

Synchrospeed Polishing

Partial Pitch Polishing

Membrane Polishing

Optical Polishing & Correction Center

- The multi-functional 6-Axis Polishing & Correction Center series MCP is an optimal machine to manufacture high-end free-forms, aspherical, spherical and plano surfaces.
- Multiple CNC axis and an innovative and unique tool concept grant the requested flexibility to achieve high end surfaces.
- The OptoTech MuliTool concept contains the following technologies and can be used in raster or spiral mode:
  - Patented Advanced Wheel Polishing Technology (A-WPT)
  - Patented Active Fluid Jet Polishing (A-FJP)
  - Membrane Polishing (FEM Tool)
  - Synchrospeed Polishing
  - Classic Pitch Polishing
  - Sub-Aperture Pitch Polishing (Partial Polishing)

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13:00-17:00 April 28 POSTER EXHIBITION HALL of BUILDING 8 (8 号楼 1 楼 展示厅)

- ✓ Research on resource management and job schedule of high performance computing in optical manufacture, Jian WANG, et al. (王建，中国工程物理研究院)(China) · [2-0037]
- ✓ Spot breeding method to predict the removal function of Magneto-rheological Finishing, Hang YANG, et al. (杨航，中国工程物理研究院)(China) ····· [2-0038]
- ✓ Beam quality measurements by modal decomposition using a spatial light modulator, Shaohua PAN, et al. (潘少华，南京理工大学)(China) ····· [2-0040]
- ✓ The Advancement of the High Precision, Chaoqiang LI, et al. (李超强，中科院光电所)(China) ····· [2-0041]
- ✓ Research of forming characteristic of precision glass molding, Zhibin WANG, et al. (汪志斌，西安应用光学研究所)(China) ····· [2-0042]
- ✓ Control of rolled edge based on the discrete local error figuring technique, Hang DU, et al. (杜航，国防科技大学)(China) ····· [2-0043]
- ✓ Research of Double Polishing Wheeled Magnetorheologial Machine Design and Polishing Process, Su YANG, et al. (杨素，山东科技大学)(China)····· [2-0046]
- ✓ Ultra-Precision molding of chalcogenide glass aspherical lens, Feng ZHANG, et al. (张峰，西安应用光学研究所)(China) ····· [2-0048]
- ✓ Process for the Φ130 sapphire window element with long distance and high resolution, Zuo SU, et al. (苏瑛，兵器 205 所)(China) ····· [2-0051]
- ✓ Optimization on manufacturing and testing Technology for rectangle aperture off-axis aspheric mirror fine grinding, Zuo CHEN, et al. (陈曦，苏州大学)(China)[2-0052]
- ✓ A Novel Method about Online Monitoring Surface Shape of Optical Elements in Continuous Polishing, Jin YIN, et al. (尹进，上海光机所)(China) ····· [2-0054]
- ✓ High-precision machining new method of wide angle and large size IR wedge mirror parts , Zuo SU, et al. (苏瑛，兵器 205 所)(China) ····· [2-0055]
- ✓ A new processing technology and detection methods for Isosceles prism, Zuo GUO, et al. (郭芮，西安应用光学研究所)(China)····· [2-0056]
- ✓ Large and medium size germanium and Silicon in infrared window parts parallel to the second difference online control law, Zuo SU, et al. (苏瑛，兵器 205 所)(China)[2-0057]
- ✓ Conformal optical window correction with tilted and decentered fixed correctors, Chunzhu ZHAO, et al. (赵春竹，长春理工大学)(China)····· [2-0058]
- ✓ Improvement of three-dimensional microstructure contour accuracy using maskless lithography technique based on DMD, Shengzhou HUANG, et al. (黄胜洲，中国科学技术大学)(China)····· [2-0059]
- ✓ Research of annular polishing asymmetric ZnS plane window, Weijin GUO, et al. (郭伟进，天津 8358 所)(China) ····· [2-0061]
- ✓ Correction on the edge collapse during the sphere Synchrospeed polishing process, Peng WANG, et al. (王朋，天津津航技术物理所)(China) ····· [2-0063]
- ✓ The technical research on fabricating high-accuracy large aperture flat SiC mirror, Heng ZHU, et al. (朱衡，成都精密光学研究中心)(China)····· [2-0064]
- ✓ Study on precision processing of L-form ZnSe deflect prisms, Sizhe YE, et al. (叶斯哲，航天三院八三五八所)(China)····· [2-0066]
- ✓ Error Analysis of Spherical Scanning Mechanism Used for Defects Detection, Haoliang XIONG, et al. (熊浩亮，浙江大学)(China) ····· [2-0067]

- ✓ Analysis of DC Control of Double-inlet Pulse Tube Refrigerators For Detectors, Bingyan DU, et al. (杜冰雁，洛阳光电发展中心)(China) ····· [5-0048]
- ✓ Manufacture of monolayer graphene field effect transistors, Zehua HUANG, et al. (黄泽华，电子科技大学)(China) ····· [5-0049]
- ✓ Measurement of scattering laser energy density distribution in optical extinctive chambers based on CCD imaging method, Weiwei LIANG, et al. (梁巍巍，中国洛阳电子装备实验)(China) ····· [5-0050]
- ✓ Thermal strain and stress distribution of ZnTe/Si(211) and CdTe/Si(211) heterostructures (ZnTe/Si), Yuanzhang WANG, et al. (王元樟，厦门理工学院)(China)[5-0051]
- ✓ Analysis of Lattice Spots Dazzling to CCD Irradiated by CW Laser, Rongzhen ZHU, et al. (朱荣臻，洛阳电子装备试验中心)(China) ····· [5-0052]
- ✓ High performance nitrogen dioxide sensor based on organic field-effect transistor utilizing ultrathin CuPc/PTCDI-C8 heterojunction, Huidong FAN, et al. (范惠东，电子科技大学)(China)····· [5-0053]
- ✓ An Efficient Algorithm Based on The Fast Fuzzy Theory for Image and Video Dehazing, Rong ZHENG, et al. (郑荣，浙江大学)(China) ····· [5-0054]
- ✓ Performance of Ternary Photovoltaic Blends Incorporating an Small Molecule Dye, Shen XING, et al. (邢珅，电子科技大学)(China)····· [5-0055]
- ✓ Color-tunable organic light-emitting devices using TPBi as exciton adjusting layer, Run WANG, et al. (王润，电子科技大学)(China)····· [5-0056]
- ✓ The research of photolithography lift-off for High-density focal plane indium bump arrays, Yingjie HE, et al. (何英杰，洛阳广电发展中心)(China)····· [5-0057]
- ✓ Theoretical investigation of a novel logic device based on plasmon-induced transparency , Yizuo YE, et al. (叶逸琛，西南大学)(China)····· [5-0059]
- ✓ A general crosstalk noise analysis model for the N-port nonblocking optical router in ONoC using WDM, Zhendong ZHANG, et al. (张振东，西南大学)(China) ····· [5-0060]
- ✓ An Optofluidic Variable Optical Attenuator Based On Magnetohydrodynamic Drive, Fenglan XUE, et al. (薛凤兰，南京邮电大学)(China) ····· [5-0062]
- ✓ Influence of surface treatment on secondary electron emission yield of MCP glass, Yonggang HUANG, et al. (黄永刚，中国建材研究总院)(China)····· [5-0063]
- ✓ Porous silicon biosensor for Echinococcosis Detection based on fluorescence spectroscopy, Xiaoyi LV, et al. (吕小毅，新疆大学)(China)····· [5-0065]
- ✓ The application of orthogonal testing method in inductively coupled plasma etching of InSb, Liwen WANG, et al. (王理文，洛阳光电技术发展中心)(China) ····· [5-0067]
- ✓ Detection of Terahertz Radiation Using Improved Uncooled Focal Plane Array Detector, Xing ZHENG, et al. (郑兴，电子科技大学)(China)····· [5-0069]
- ✓ Design and analysis of a polarization splitter based on dual-core photonic crystal fiber, Zhenpeng WANG, et al. (王振鹏，哈尔滨工程大学)(China) ····· [5-0070]
- ✓ A novel method to real-time bias correction for frame transfer CCD, Zhi CHEN, et al. (陈智，中科院西安光机所)(China) ····· [5-0071]
- ✓ Controllable preparation and optical properties of Ag columnar thin films, Xu HUANG, et al. (黄旭，中山大学物理学院)(China) ····· [5-0072]
- ✓ Synthesis of Cu2ZnSnSxSe4-x (CZTSSe) Film with Ultrasonic Spray Pyrolysis Deposition method, Jiang CHENG, et al. (程江，重庆文理学院)(China) ····· [5-0073]
- ✓ Study on the technology of underfill for the InSb infrared focal plane detector, Dongfeng GENG, et al. (耿东锋，洛阳光电技术发展中心)(China) ····· [5-0074]

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苏州交通旅游图
SUZHOU TRAFFIC MAP FOR TOURIST
旅游景观 Scenic Spots
(A) Humble Administrator's Garden
(B) Lion Grove Garden
(C) North Temple Pagoda
(D) Mountain Villa of Secluded Beauty
(E) Garden of Couples
(F) Joyous Garden
(G) Confucian Temple
(H) Surging Waves Pavilion
(I) Garden of the Master of Nets
(J) Three Sights of Panmen
(K) Suzhou Museum
Tiger Hill Scenic Zone
West Garden
Lingering Garden
Suzhou Amusement Park
Tianping Hill
Lingyan Hill
Guanqian Mercantile Street
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