Fabrication Of Complex Optical Components From Mold Design To Product Lecture Notes In Production Engineering

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Optical components fabrication by thinfilmscience.com Optics Manufacturing

Optical Systems Engineering: It's Not Just the Optics! (8/29/2012)**Vision Optics | High quality optical components and assemblies** ~~Lecture 43 - Diffractive Optics~~ ~~Semiconductor Fabrication Basics - Thin Film Processes, Doping, Photolithography, etc.~~ ~~Micro Lenses made with Photolithography.~~ ~~Basics of Optical Surfaces~~ Silicon Photonics for Optical Interconnects - Rising Stars 2014 *Optical Properties of Nanomaterials 06: Mie theory and applications of dielectric particles*

Thorlabs Plano Optics Manufacturing~~How an EO Imaging Lens is Manufactured~~ PCB Manufacturing Video ~~How a CPU is made~~ Optical lens manufacturing--Polishing \u0026 Centering Op-Art Pop-Art - Patterns on the Sphere - #StayHome and draw #WithMe ~~GT Advanced - Sapphire Glass Production~~

Electronics Manufacturing UK - PCB Assembly Overview of Optical Polishing/Finishing Machines - OptiPro Systems

Canon Lens Production 1

Carl Zeiss S-planar lens pt.1: general discussion*Barberini Manufacturing Process* ~~Active Micro Optics - 03: Fabrication 1~~ ~~How to design a Metalens/Metasurface? || Metasurfaces tutorial || MetaOptics software demo.~~ ~~Ultra precision Machining: An Enabling Technology for Nano metric surface Finish~~ ~~2020 Virtual Economic Outlook Forecast - Speaker Segment with Peter Zeihan~~ *Thorlabs Specialty Optical Fiber Manufacturing PhotoTechEDU Day 30: Imaging optics for the* *next decade* **Edmund Optics Manufacturing: We Make It 12. Thin Films: Material Choices \u0026 Manufacturing, Part I Fabrication Of Complex Optical Components**

High quality optical components for consumer products made of glass and plastic are mostly fabricated by replication.

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Fabrication of Complex Optical Components - From Mold ...

Fabrication of Complex Optical Components: From Mold Design to Product Robert Schmitt , Peter Becker (auth.) , Ekkard Brinksmeier , Oltmann Riemer , Ralf M. Gläbe (eds.) High quality optical components for consumer products made of glass and plastic are mostly fabricated by replication.

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Fabrication of Complex Optical Components From Mold Design to Product Spri inger . Contents Total Quality Management in the Replication Process of Sophisticated Optical Elements 1 Robert Schmitt, Peter Becker Mold

Design for Complex Optical Plastics Components 13

Fabrication of Complex Optical Components

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Fabrication of complex optical components : from mold ...

Optical fabrication and testing spans an enormous range of manufacturing procedures and optical test configurations. The manufacture of a conventional spherical lens typically begins with the generation of the optic's rough shape by grinding a glass blank. This can be done, for example, with ring tools. Next, the lens surface is polished to its final form. Typically this is done by lapping—rotating and rubbing the rough lens surface against a tool with the desired surface shape, with a ...

Fabrication and testing of optical components - Wikipedia

Contract Manufacturing> Fabrication> Replication Process. Replication Process. Optical Replication Provides Cost-Effective, Volume Production of Complex Optical Surfaces. Overview. Optical Replication achieves high optical accuracy and tolerances while realizing numerous benefits, particularly lower costs and reduced complexity. Suited to applications requiring anywhere from only a few, to hundreds or even thousands of precision optical components, Replicated Optics include mirrors of nearly ...

Optical Replication of Complex Optical Surfaces

Complex and Custom Optics - Salvo Electro Optics can produce complex optical components. From Amici and Penta prisms to complex aspheres Salvo Electro Optics has you covered. CNC capabilities allow Salvo Electronics to produce a range of complex shapes and sizes in a multitude of optical materials.

Complex Optical Components | salvo-technologies

Precision glass molding is becoming a promising technology for fast production of complex optical glass components in high volume. It is a replication process and becomes economical after a few batches.

Process Chain for the Replication of Complex Optical Glass ...

Reynard Corporation manufactures custom optical components and thin-film coatings from 0.2 to 50 microns (UV to far-IR), in-house diamond turning, optical fabrication, photolithography pattern optics, environmental testing, and design services. Prototype to production, ISO 9001:2015 certified, ITAR registered, and Cybersecurity

(CMMC) compliant.

Custom Optics Manufacturing Companies | Photonics Buyers ...

We provide custom optical systems from initial concept development to production systems. We work with researchers, product developers, and production engineers as a partner or an outsourced specialist in optical science and technology. We have the unique ability not only design but to also build systems or components for a variety of industries utilizing optics.

Opticology | Optical Design and Engineering Experts

Optical Replication achieves high optical accuracy and tolerances while realizing numerous benefits, particularly lower costs and reduced complexity. Suited to applications requiring anywhere from only a few, to hundreds or even thousands of precision optical components, Replicated Optics include mirrors of nearly any surface shape or amplitude ...

Optical Replication of Complex Optical Surfaces

"Having the ability to fabricate optics with different shapes and optical parameters offers a solution to common problems faced in optics," said Braun, who is a professor of materials science and engineering. "For example, in imaging applications, focusing on a specific object often results in blurry edges.

New 3D-Printed Microlenses With Adjustable Refractive ...

Large Optical Elements. Supersize your components! Cosmo Optics specializes in large optical components. We regularly manufacture prisms, lenses and plano components 14″ to 26″. We have produced components over 40″ in diameter within the past year. Our fabrication methods, equipment and personnel excel at the art of making large optical ...

Products - Cosmo Optics

Team members said they expect that their method will significantly impact the manufacturing of complex optical components and imaging systems and will be useful in advancing personal computing.

Researchers confront optics and data-transfer challenges ...

Caliper looks for opportunities to explore the fabrication of complex geometry through simple fabrication methods. One example is a bent metal rain screen panel system constructed of sheet metal with different sized notches removed from each corner and the edges folded to form a standoff and attachment flange.

High quality optical components for consumer products made of glass and plastic are mostly fabricated by replication. This highly developed production technology requires several consecutive, well-matched processing steps called a "process chain" covering all steps from mold design, advanced machining and coating of molds, up to the actual replication and final precision measurement of the quality of the optical components. Current market demands for leading edge optical applications require high precision and cost effective parts in large volumes. For meeting these demands it is necessary to develop high quality process chains and moreover, to crosslink all demands and interdependencies within these process chains. The Transregional Collaborative Research Center "Process chains for the replication of complex optical elements" at Bremen, Aachen and Stillwater worked extensively and thoroughly in this field from 2001 to 2012. This volume will present the latest scientific results for the complete process chain giving a profound insight into present-day high-tech production.

Applications of precise optical components with complex shapes are becoming more popular because of demands for more accurate, smaller size optical components. Although fabrication techniques of the components have advanced in recent years, only molding based methods are typically suitable for mass production. On the other hand, molding based methods are less capable of creating complex optical components. To deal with these limitations, a process based on nickel electroforming is introduced to replicate mold inserts directly from a plastic optical component, which itself can be fabricated by any fabrication methods with high flexibility. Then, using the plated mold insert in precision compression molding, the optical components are replicated. To investigate replication capabilities of the developed method in fabrication of plastic optical components, a polymethylmethacrylate (PMMA) microlens array was replicated to a nickel-plated mold first from another plastic microlens array then mass-produced using compression molding process. Properties of both microlens arrays, were investigated for geometrical accuracy, surface quality, and optical performance. The results demonstrated a promising technique to manufacture plastic optical component with high production rates. Fabrication capabilities of the method in production of infrared optics was also evaluated through producing an infrared microlens array from a plastic microlens array. Comparison between the fabricated infrared microlens array and the plastic microlens array in terms of geometry, surface quality, and optical performance has shown that it is a promising technique for replicating infrared microlens arrays. Using the developed method, a new fabrication method of non-planar optical component with large area was also proposed and demonstrated by producing micro feature on a cylindrical surface. The technique was capable to transfer micro-optical features from a planar surface, which is much easier to produce, to non-planar surfaces. To assess possibility of fabricating complex glass optical surfaces using the developed fabrication technique, a nickel mold of diffractive harmonic diffractive lens (HDL) from a plastic HDL was made. Then, the mold and precision compression molding were used to fabricate glass harmonic diffractive lens. Geometrical analysis and optical performance of the plastic and the fabricated HDL showed that the method is capable to be used in fabrication of precision glass optics as well. Precision compression molding is one of the most suitable mass production methods of optical components with micro/nanoscale surface features. This process suffers from long heating and cooling cycles. To deal with the challenge, a novel precision compression molding was proposed. In the proposed process, induction heating of a thin nickel mold insert is used. In the process, the nickel mold insert is replicated from a plastic optical component as described before. To evaluate cooling and heating cycles of the method, a numerical model of the heating system using finite element method (FEM) was created and run in this research. According to simulation results, heating and cooling rates were significantly improved. Geometrical analysis and optical performance evaluation of the replicated microlens array have shown that the proposed fabrication method has a potential to reduce the problems of conventional bulk heating system.

The main focus of this dissertation is to seek scientific and fundamental knowledge of nonconventional optical components including its optical design, ultraprecision prototyping, precision molds making, transition into industrial production and efficient evaluation. A nonconventional component in this dissertation is loosely defined as an optical component either that is not symmetric around its optical axis or that is aspherical surface with three or higher order coefficient. Nonconventional optics have broadened the vision of optical designers and enhanced the design flexibility and thus are becoming increasingly important as a core next-generation optical component. These optical components have gradually been implemented to replace conventional spherical and aspherical counterparts in the fields of imaging (Plummer, 1982), illumination (Fournier & Rolland, 2008), aviation (Spano, 2008) , and energy (Zamora, et al., 2009) where freeform optics have demonstrated excellent optical performance and high degree of system integration. However, design, fabrication and metrology of nonconventional optics have not been developed at the same pace. Due to the complex nature of nonconventional optics manufacturing processes, the production efficiency and finished quality of nonconventional optical components are difficult to be improved. To validate optical performance, in this dissertation ultraprecision diamond tooling is applied to prototype the optical design, which is capable of generating precision optical features both on polymer blank and metal mold without post grinding and polishing process. In addition, the prototyping process also paves the way to mold fabrication. To produce low cost high volume high quality nonconventional optical components, precision compression/microinjection molding has been combined with ultraprecision diamond machining and cleanroom manufacturing respectively for different size scale and application. Once the low cost molded nonconventional optical components and assembly are fabricated, their optical performance needs to be characterized to ensure quality in industrial production. The geometric feature and principle optical parameter, such as focal length, are two important aspects that influence the final optical performance considerably. In order to solve the major problems in manufacturing affordable high quality nonconventional optical components, this dissertation will include several key steps: 1) Investigate nonconventional optics design that could be functionally and economically applied in various optical components or systems to further improve their performance; 2) Validate and evaluate nonconventional optics design by ultraprecision prototyping; 3) Develop the precision molds manufacturing process and the corresponding molding process both for miniaturized lens profile and micro scale diffraction structure; 4) Investigate the products quality by crucial optical parameters measurement and surface profiling. Overall, this dissertation describes a comprehensive understanding of low cost high volume nonconventional optics manufacturing.

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Optical science and engineering affect almost every aspect of our lives. Millions of miles of optical fiber carry voice and data signals around the world. Lasers are used in surgery of the retina, kidneys, and heart. New high-efficiency light sources promise dramatic reductions in electricity consumption. Night-vision equipment and satellite surveillance are changing how wars are fought. Industry uses optical methods in everything from the production of computer chips to the construction of tunnels. Harnessing Light surveys this multitude of applications, as well as the status of the optics industry and of research and education in optics, and identifies actions that could enhance the field's contributions to society and facilitate its continued technical development.

This book provides details on various micro and precision manufacturing and finishing operations performed by conventional and advanced processes, including micro-manufacturing of micro-tools and precision finishing of engineered components. It describes the process mechanism, principles and parameters while performing micro-fabrication and precision finishing operations. The text provides the readers with knowledge of micro and precision manufacturing and encourages them to explore the future venues in this field.

Good optical design is not in itself adequate for optimum performance of optical systems. The mechanical design of the optics and associated support structures is every bit as important as the optics themselves. Optomechanical engineering plays an increasingly important role in the success of new laser systems, space telescopes and instruments, biomedical and optical communication equipment, imaging entertainment systems, and more. This is the first handbook on the subject of optomechanical engineering, a subject that has become very important in the area of optics during the last decade. Covering all major aspects of optomechanical engineering - from conceptual design to fabrication and integration of complex optical systems - this handbook is comprehensive. The practical information within is ideal for optical and optomechanical engineers and scientists involved in the design, development and integration of modern optical systems for commercial, space, and military applications. Charts, tables, figures, and photos augment this already impressive handbook. The text consists of ten chapters, each authored by a world-renowned expert. This unique collaboration makes the Handbook a comprehensive source of cutting edge information and research in the important field of optomechanical engineering. Some of the current research trends that are covered include:

This edited volume reviews the current state of the art in the additive manufacturing of optical componentry, exploring key principles, materials, processes and applications. A short introduction lets readers familiarize themselves with the fundamental principles of the 3D printing method. This is followed by a chapter on commonly-used and emerging materials for printing of optical components, and subsequent chapters are dedicated to specific topics and case studies. The high potential of additive manufactured optical components is presented based on different manufacturing techniques and accompanied with extensive examples - from nanooptics to large scale optics - and taking research and industrial perspectives. Readers are provided with an extensive overview of the new possibilities brought about by this alternative method for optical components manufacture. Finally, the limitations of the method with respect to manufacturing techniques, materials and optical properties of the generated objects are discussed. With contributions from experts in academia and industry, this work will appeal to a wide readership, from undergraduate students through engineers to researchers interested in modern methods of manufacturing optical components.

SU-8 is a very promising material for micro-optics. It is mechanically robust with high thermal and chemical resistance, has high transmission at visible and near-infrared wavelengths, and has relatively high refractive index after curing. While lithographic processing of SU-8 is relatively common, molding of SU-8 requires different processing parameters due to challenges with solvent removal and cross linking. Understanding the effects of the molding process on SU-8 is necessary to optimize performance of molded micro-optical components, and also to enable fabrication of more complex micro-optics through subsequent lithographic processing of molded structures. In this thesis, we explore techniques for micromolding of micro- and nano-optics in SU-8 and examine properties of SU-8 as it undergoes the molding process. Elastomeric mold templates are first cast from master structures fabricated using standard techniques. The elastomeric templates are then used in low pressure molding processes to produce high-fidelity refractive and diffractive micro-optics in SU-8. The use of the elastomeric mold templates enables realization of a wider variety of optical surfaces than can be achieved with conventional lithographic patterning in SU-8, and further enables conformal fabrication of SU-8 micro-optics on non-planar surfaces. Molding processes and experimental results for both thin (diffractive) and thick (refractive) elements are presented. Replication of SU-8 micro-optics on both planar and non-planar surfaces, and hybrid processes combining molding and lithographic exposure are demonstrated. SU-8 dimensional changes during processing are characterized, and minimum moldable feature sizes are explored. Solvent content and refractive index as functions of processing parameters are also examined, along with analysis of the SU-8's lithographic properties after undergoing the molding process. The intermediary molds are characterized for shrinkage, and mold lifespan is explored. These characterizations further enable hybrid combinations of micro-molding and lithographic processing to fabricate complex micro-optics that are difficult or impossible to realize using conventional techniques.

The technologies for product assembly and manufacturing evolve along with the advancement of enabling technologies such as material science, robotics, machine intelligence as well as information and communication. Furthermore, they may be subject to fundamental changes due to the shift in key product features and/or -

gineering requirements. The enabling technologies emerging offer new opportunities for moving up the level of automation, optimization and reliability in product assembly and ma- facturing beyond what have been possible. We see assembly and manufacturing becoming more Intelligent with the perception-driven robotic autonomy, more flexible with the human-robot coupled collaboration in work cells, and more in- grated in scale and complexity under the distributed and networked frameworks. On the other hand, the shift in key product features and engineering requirements dictates the new technologies and tools for assembly and manufacturing to be - veloped. This may be exemplified by a high complexity of micro/nano system products integrated and packaged in 3D with various heterogeneous parts, com- nents, and interconnections, including electrical, optical, mechanical as well as fluidic means.