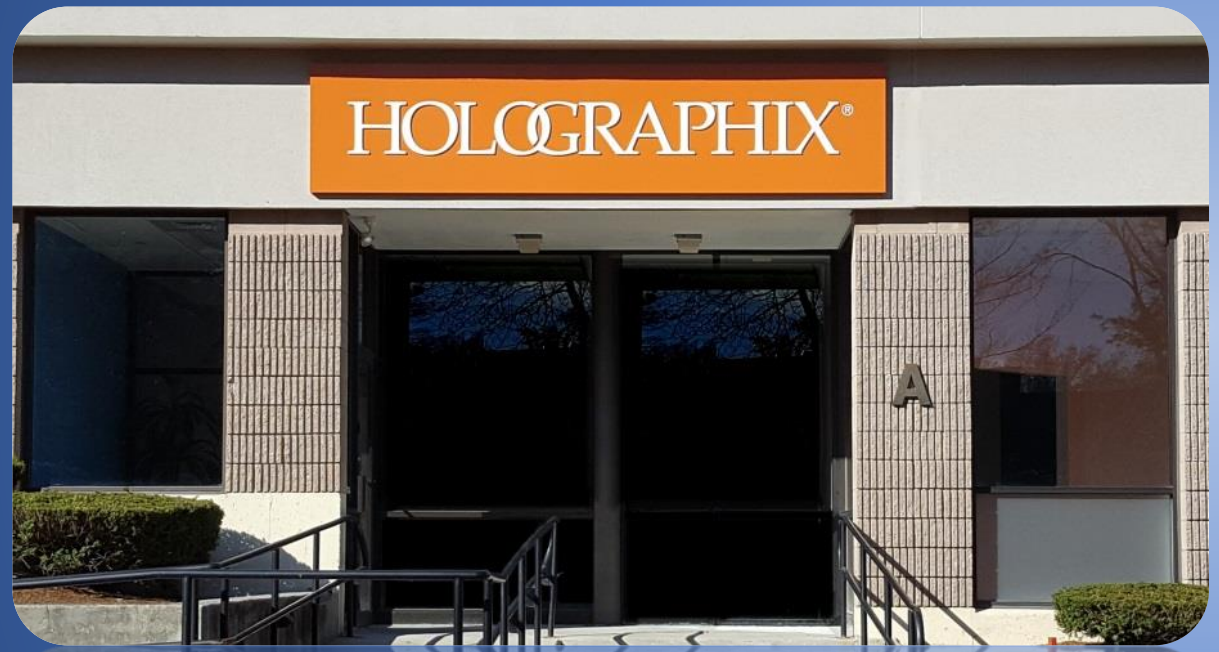
HOLOGRAPHIX® LLC
Creating a Spectrum of Optical Solutions
2022 COMPANY OVERVIEW

COMPANY PROFILE



- One location in Marlborough, MA. 15,000 sq. ft. facility with additional space available for expansion
- Business based on proprietary replication technology, manufacturing technology and materials
- Facility outfitted for volume manufacturing of high quality optics and surface relief patterned components
- Management committed to maintaining Holographix' position as a leader in the replicated component and sub-assembly markets

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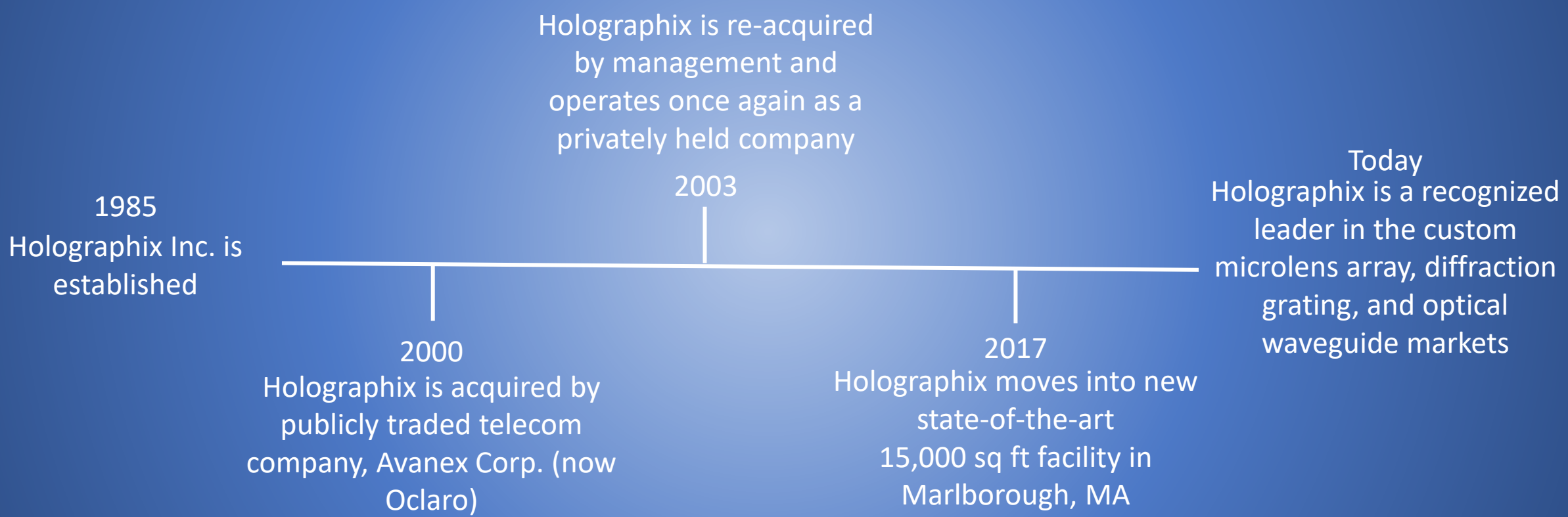
COMPANY HISTORY



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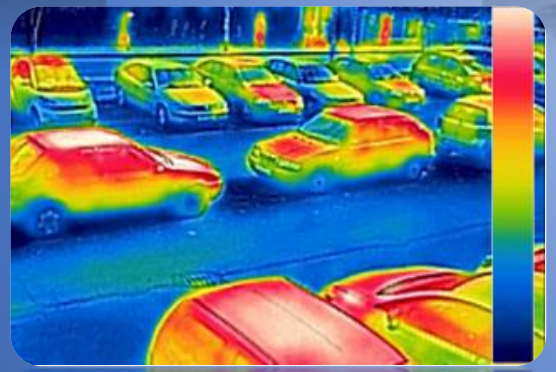
MARKETS



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MARKETS

AEROSPACE & DEFENSE

- Waveguides for Head-Worn Displays (HWD)
- Waveguides for Heads-Up Displays (HUD)
- MLAs and Diffusers for HUD input optics
- Mirrors for Military and Satellite applications
- Gratings for Space-Based applications

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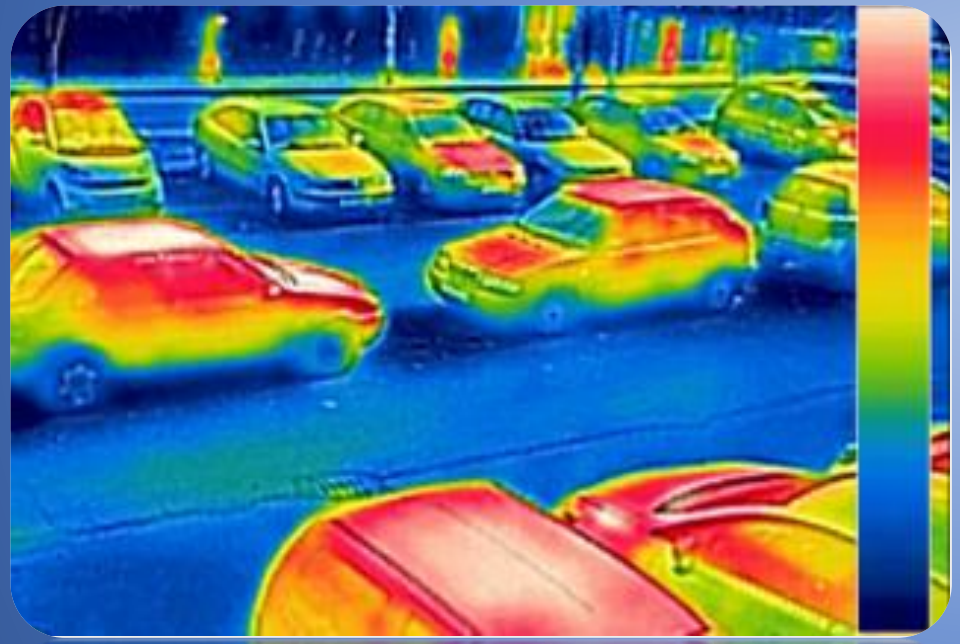
MARKETS

AUTOMOTIVE



- Wafer-level MLAs for Lidar (autonomous vehicles)
- Wafer-level MLAs for Advanced Lighting

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MARKETS

CONSUMER ELECTRONICS

- Waveguides for AR/VR Displays
- Wafer-level MLAs used in Sensor-Based Devices
- Wafer-level DOEs used in Sensor-Based Devices
- Wafer-level MLAs for AR/VR Displays
- Gratings for AR/VR Displays

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MARKETS

INDUSTRIAL

- Waveguides for AR Displays
- Wafer-level MLAs for Internet of Things
- Wafer-level MLAs for Advanced Lighting
- Gratings for Metrology Devices
- Gratings for Telecom Devices
- Gratings as Calibration Standards
- Gratings/Mirrors for Laser-Based Applications

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MARKETS

LIFE SCIENCES

- MLAs for Medical lasers
- Wafer-level MLAs for Capsule Endoscopy
- Gratings/Mirrors for Spectroscopy/Analytical Chemistry
- Gratings for Ocular Metrology Devices
- Wafer-level MLAs for Ocular Metrology Devices
- Microstructures for Microfluidic Devices

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CUSTOMERS

Our Customers range from start-up companies to fortune 500 companies.
Below are a few companies that Holographix is proud to work with:

PerkinElmer

Celera MOTION

COHERENT

CYNOSURE Be transformed

BAE SYSTEMS INSPIRED WORK

Newport

NIDEK

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CORE COMPETENCIES

Holographix maintains its market leadership in Replicated Optical Component Manufacturing through the following core competencies:

- Optical design services for custom diffraction gratings, microlens arrays, diffusers, and diffractive optical elements (DOEs)
- Thin film coating design services
- Engineering and fabrication of custom tooling required to achieve customers specifications
- Mastering custom slanted and blazed structures
- High volume wafer-level processing, included wafer alignments to patterned coatings, and double sided wafers.
- Metrology and Quality capabilities

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MANUFACTURING OPERATION

- Set up to rapidly respond to customer requirements
- Continuous improvement is engrained into the company culture, with many of the industry leading best practices employed including 5S, lean, 6-sigma, training programs, customer and employee feedback, supplier management, obsolescence programs
- Quality control is driven by a rigorous ISO 9001-2015 certified Quality Assurance Program
- Employee incentive program focused on manufacturing yield improvements and customer on-time delivery
- Long-term relationships established with key suppliers to help ensure on-time delivery of quality products

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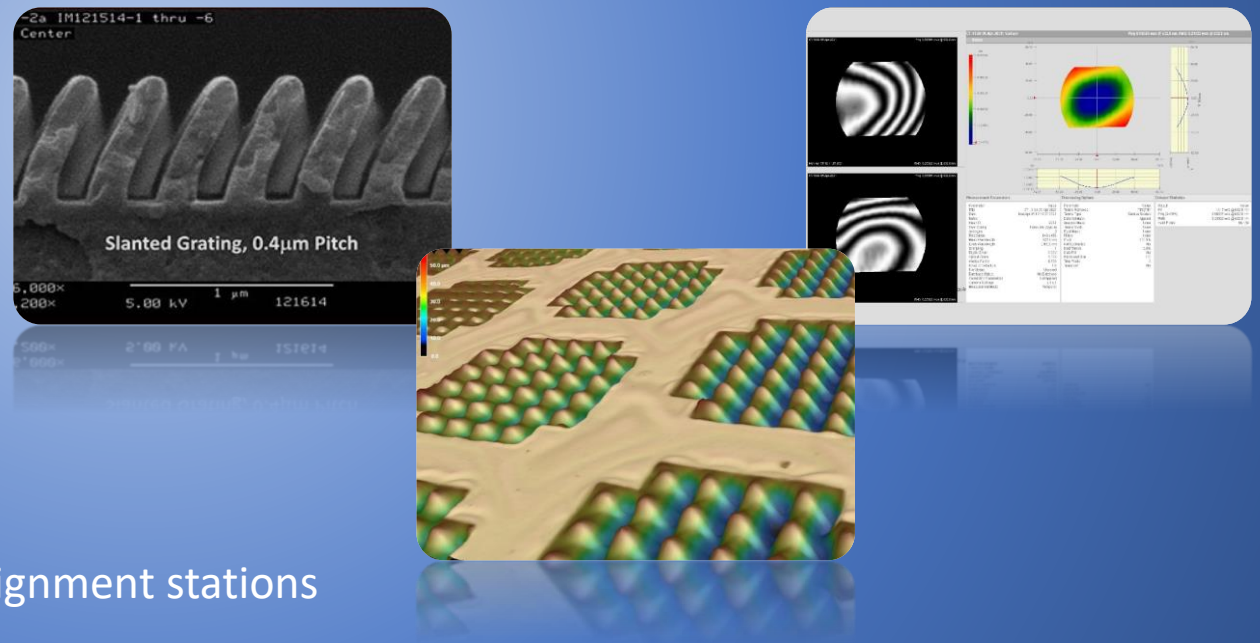
METROLOGY CAPABILITIES

Holographix' facility is equipped with precision metrology equipment and a knowledgeable staff trained to operate the equipment.

Equipment List Includes:

- Confocal Microscope
- Scanning Electron Microscope (SEM)
- Atomic Force Microscope (AFM)
- Vision Measurement Systems (VMS)
- Phase Shifting Interferometers
- Automated diffraction grating efficiency testers
- Custom wafer-level replication and micron-class alignment stations
- Custom equipment for manufacturing and testing diffraction gratings



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DESIGN CAPABILITIES

Holographix offers optical design support using the following software packages:

Optical Design for Diffraction Gratings, Microlens Arrays, and Diffusers:

Zemax

Grating Diffraction Efficiency Modeling:

IIG PCGrate

GSolver
Rigorous Diffraction Grating Analysis

Thin Film Coating Design:

Essential Macleod

Opto-Mechanical Design:

SOLIDWORKS

DraftSight

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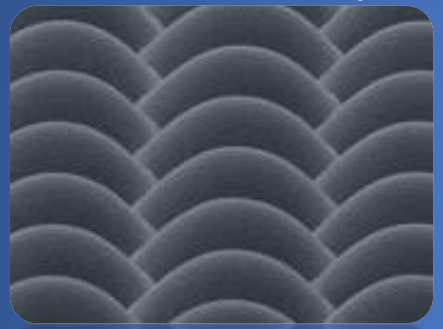
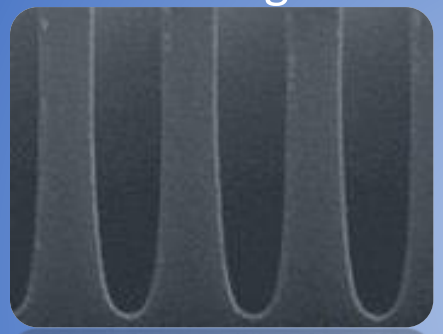
PRODUCTS

Holographix is a Custom Manufacturer of:

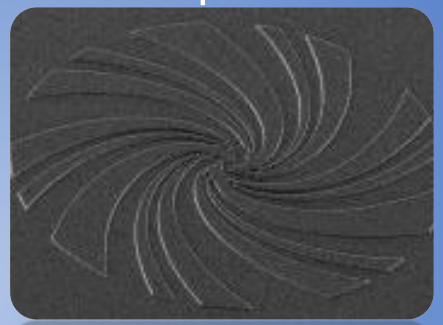
Microlens Arrays



Gratings



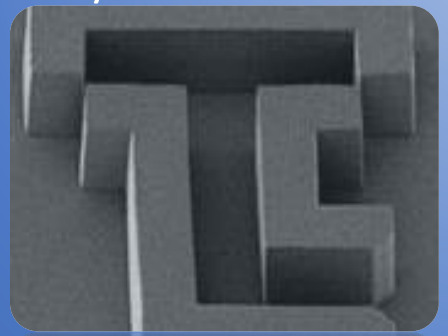
Diffractive Optical Elements



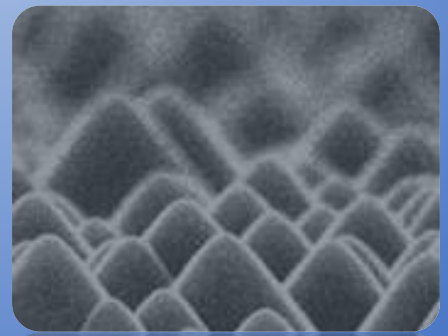
Waveguides

Wafer Optics

Nano/Micro Structures



Diffusers



Replicated Mirrors

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PRODUCT APPLICATIONS

Product Applications:

- Grating-Based Spectrometer Systems
- Waveguide-Based HUDs and HMDs
- Microlens Array-Based Sensor Systems
- Microlens Array-Based Lightfield Imagers
- Aesthetic Laser Treatment Systems
- Tunable Laser Systems
- Micro-Fluidic Devices

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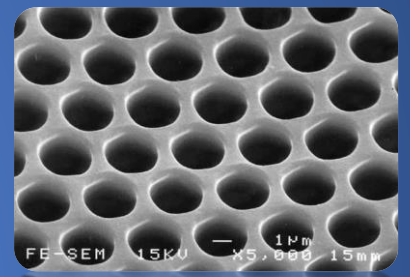
MICRO/NANO-MOLDING

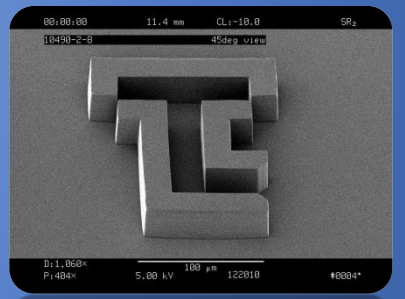
Advantages include:

- Cost-effective approach to low, medium, and high volume production without compromising quality
- Reduced risk to initial master investment through multiple generations of replicated stampers
- Proven ability of replicated stampers for production of nickel shims for injection molding and hot embossing
- High repeatability from part-to-part and batch-to-batch

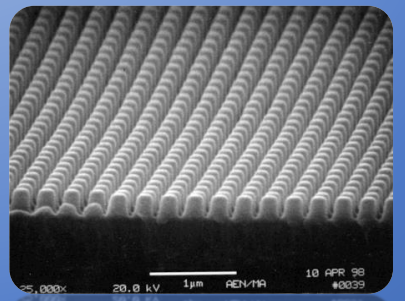
Microwells



Microfluidic Pattern



Antireflective moth-eye surface



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PROPRIETARY REPLICATION POLYMERS

Holographix utilizes a number of different proprietary chemistries to enable our replication process. Common material properties include:

- **Room temperature UV curable polymers**
  - Eliminates thermal stress equating to higher fidelity
- **Uncured polymers exhibit excellent flow characteristics**
  - Allows for manufacture of high aspect ratio relief patterns
- **Cured polymers exhibit desirable properties**
  - Excellent adhesion to substrate
  - Excellent release from mold
  - Refractive indices ranging from 1.4 to 1.68 are available
  - Thermally stable from –55 to >+200 degrees C
  - Chemically resistant to most solvents, acids, and bases
  - UV durable and transparent from λ350nm to 2700nm
  - Low surface roughness due to absence of release layer

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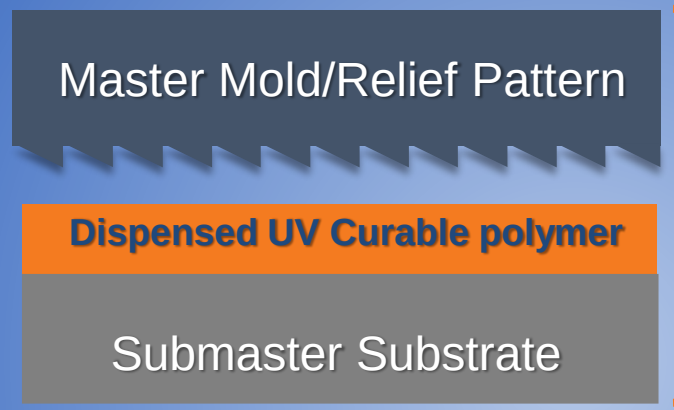
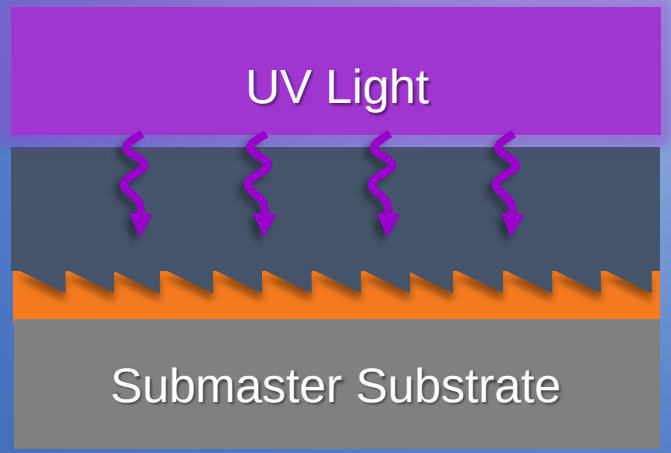
BASIC POLYMER REPLICATION PROCESS

1



At least one substrate must be UV transparent

2



Assemble and room temperature UV cure

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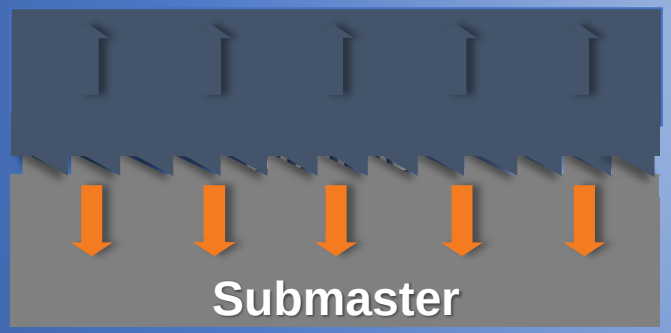
BASIC POLYMER REPLICATION PROCESS

3



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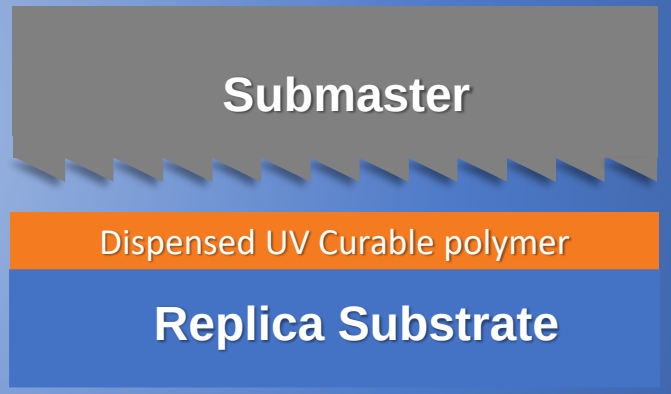

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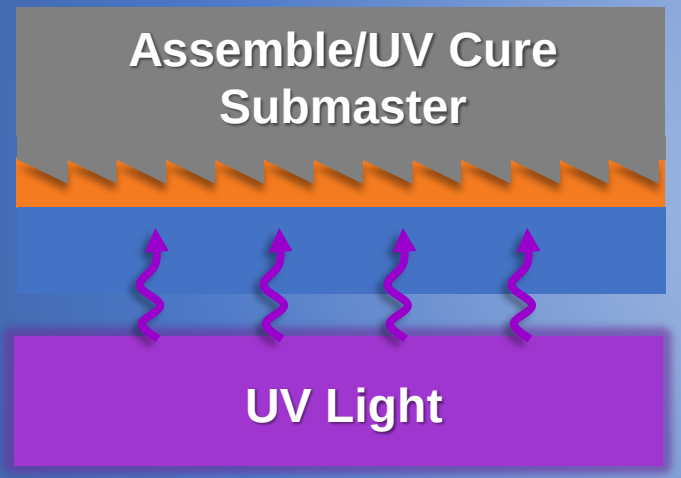
BASIC POLYMER REPLICATION PROCESS

5



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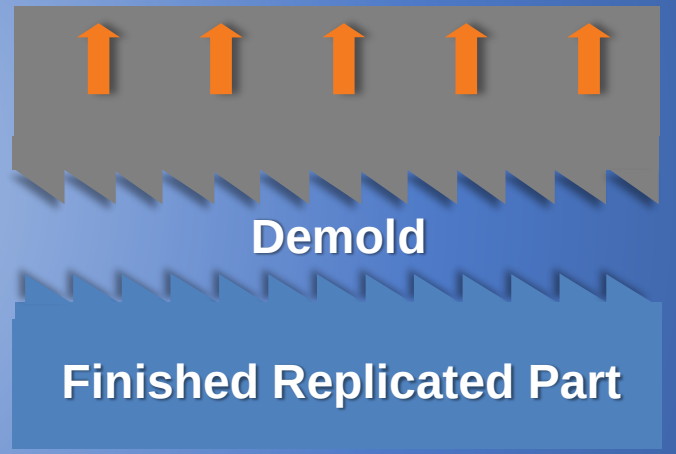

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BASIC POLYMER REPLICATION PROCESS

- Surface shape precisely replicated to <1/10λ
- Polymer is highly transparent from 350nm to 2700nm
- Can be coated with a variety of thin-films coatings
- Process is highly scalable

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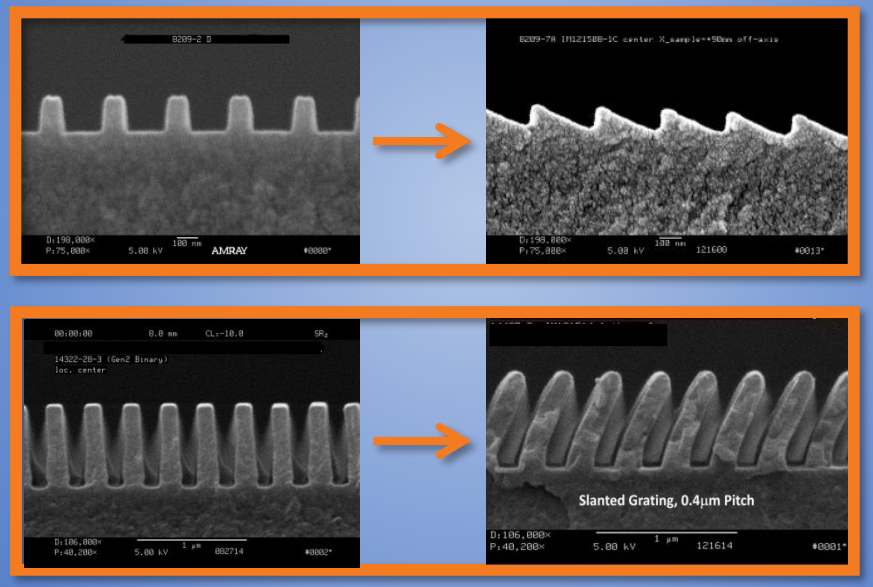
ION-BEAM MICRO-MILLING

Holographix has developed an Ion-Beam Micro-Milling process to create large area blazed and slanted stampers from replicated binary stampers.



This capability allows us to create both small and large waveguides and other products with high optical throughput.

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ASPHERICS

Holographix offers a cost-effective solution for the production of high quality aspheres in OEM quantities.

- For use in either transmission or reflection
- Can be produced on low-cost spherical surfaces
- Higher production rates and lower cost compared to grinding and traditional polishing without reduction of quality
- Higher repeatability part-to-part compared to polishing
- Aspherics can be used in place of multi-element lens assemblies

Aspheric Mirrors

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METAL MIRRORS

Holographix offers flat, spherical, and aspheric mirrors on metal substrates.

Advantages Include:

- **Minimized system weight and cost.**
- **Simplified system design by eliminating glass substrate, placing the mirror surface directly onto the metal mount.**
- **Machinable materials (Al, Be, etc.) can be used to produce replica substrates:**
  - Pre-machined alignment tabs, mounts, and other design features
  - Direct assembly into the final system
  - Matching CTE for reduced distortion over temperature
- **Design and manufacturing flexibility at a lower unit cost than conventional glass mirrors in many cases.**

Metal Mirrors

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SUMMARY

Holographix has developed and optimized cost-effective proprietary optical manufacturing technology that has been successfully applied across several industries.

Holographix is well-positioned to service the growing demand for high quality custom replicated optics and assemblies in production volumes.

Holographix' proven experience in the manufacture of custom replicated microlens arrays and diffraction gratings and has allowed us to penetrate major markets including LIDAR, HUD, HMD, AR, VR, and Lightfield Imaging.

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