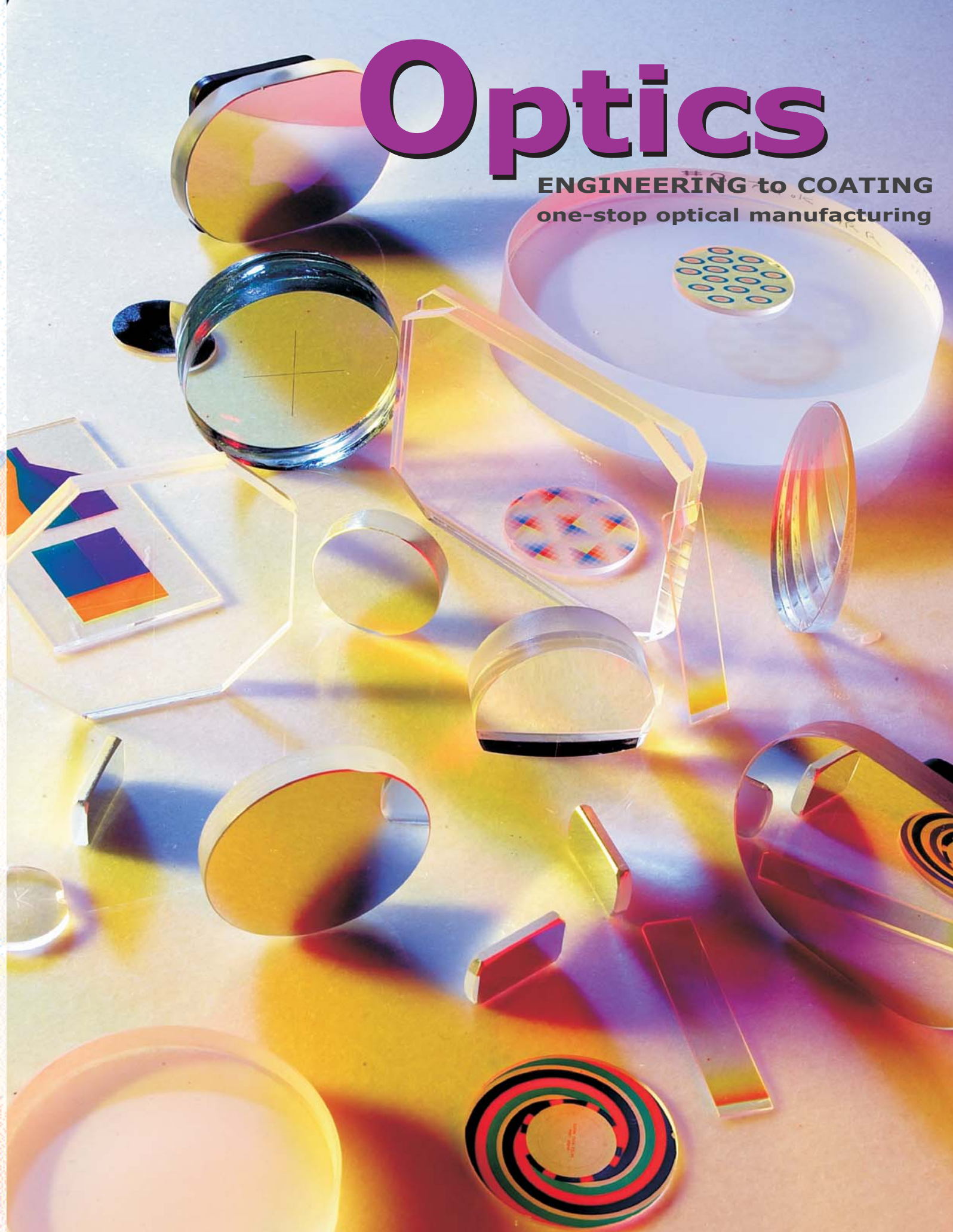

Optics
ENGINEERING to COATING
one-stop optical manufacturing

MARKETS

Our optics and patterned dichroic optical filters can be integrated into a variety of applications, including coated envelopes for the architectural lighting industry, data projection color wheels for consumer electronics markets, CCD camera and spectral imaging filters for scientific instrumentation, targeting systems and optics for the military, and optical networking components for telecommunications development.

Because of our services, technology and expertise, we can manufacture mid- to high-volume precision optical components, filters, subassemblies and metrology instruments for a wide range of industries. At right is just an overview of the kinds of optics and filters utilized in various markets that we serve.

Entertainment/Lighting

- AR coatings for GOBOs
- Broadband anti-reflection coated filters for entertainment lighting
- Coatings for light envelopes
- Dichroic filters for stage lighting
- Filters for special effects lighting
- Hot and cold mirrors for lighting fixtures

Consumer Electronics

- Dielectric coatings for personal digital assistant (PDA) screens
- RGB filters for LCD and projection displays
- Patterned GOBOs for projection systems
- Color Wheels for HDTV, high-definition monitors, and rear-projection TVs
- UVA-B-C camera filters for photography

Military

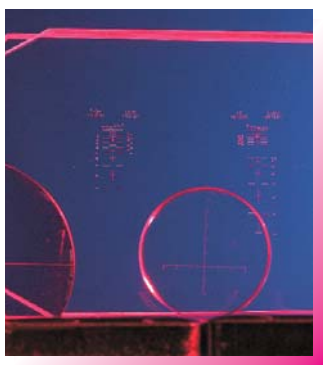
- Reticles: direct-view, side-illuminated, projection, dark-field, light-field)
- Binoculars
- Bore-sighting devices
- Fire control
- Rifle scopes
- Rangefinder reticles
- Complex optical targeting systems
- Precision optics for E-O systems

Scientific Instrumentation

- Bandpass filters for medical fiber-optic instruments and wavelength-selective detectors
- Hyper-spectral imaging filters for CCD cameras
- Multi-layer RGB color filters for CCD detectors
- Second- and third-order blocking filters for spectroscopy
- Spectroscopic kits for optics inspection
- Optics for optical benches in spectrometers

Metrology

- Flats for inspecting optical components
- Collimation Testers for examining and adjusting the collimation of laser beams
- Spectroscopic kits for optics inspection
- NIST-traceable reflection standards



Optical Networking

- AR coatings for network components
- Bandpass filters, gain flatterners and rejection filters for DWDM
- Micromechanical device filter elements (MEMS), waveguide relays and switches
- Filters for wavelength add/drop couplers
- Tunable filters for transmitters and receivers

Advantages of Precision Patterning

✓ **Superior Resolution.** Coated areas as small as 2 μm, with spatial registration to within 1 μm.

Other coating technologies can only acheive patterns to 40 μm, with 2 μm spatial resolution.

✓ **Transmission Efficiency.** Patterned filters have superior transmission and blocking efficiency for demanding high-resolution digital imaging.

Gels and colored glasses can't come close to our transmission properties.

✓ **Flexibility.** On one substrate, we can manufacture intricate coating patterns of any shape, apply multiple images and combine different coatings types.

Cut metal-mask techniques have inherent machining limits.

✓ **Unmatched Color.** Transmission efficiency and resolution provide superior brightness, sharpness, clarity and color purity.

Other technologies can't provide our degree of color saturation.

✓ **Low Cost.** Microlithographic tooling does not increase significantly with the complexity of the pattern.

Other coating techniques add costs for intricate patterns.

✓ **Durable and Robust.** Our process provides coatings with permanent color that can handle high temperatures (700 °F), humidity and shock.

Metal masking damages easily and requires frequent cleanings. Other technologies result in fading, cracking and peeling.

✓ **Mechanically Sound.** Because we apply coatings directly to substrates, they are more resistant to shock and vibration.

Discrete filter substrates that are bonded together have poor mechanical tolerances.

OFF-THE-SHELF

Ocean Optics is a diversified photonics and electro-optics company. Over a decade of working with spectrometers, fibers and optics has taught us what works and what doesn't in the industry. Now we're applying those lessons to the development of complementary technologies, to make us -- in the truest sense -- a full-service supplier of electro-optic systems and optical components.

In 1999, Ocean Optics announced the creation of a division focused on the commercialization of optics and innovative thin film technologies. We wanted not only to produce the filters and optics used in our fiber optic spectrometers and accessories and control the quality and supply of these components, but also to develop into a full-service optics and coatings manufacturer.

Now we can offer off-the-shelf and custom filters and precision optics for those in markets as diverse as the military and the entertainment industry. We provide optical services from machining and microlithography to etching and QC testing. And we continue to plan our growth in the world of optics.

Optical Flats

An Ocean Optics Optical Flat is a finely polished flat surface used as a reference to visually inspect optical components such as mirrors, filters, prisms and windows. We offer 32 different single-sided optical flats in fused silica or Zerodur, with or without an aluminum coating to increase contrast and improve the visual reference. The flats range in size from 1" to 6" in diameter and are available in in 1/20λ, 1/10λ or 1/4λ flatness accuracies.

from $200 to $1,850
custom flats available

Linear Variable Filters

Linear variable high-pass, low-pass, and adjustable-bandwidth bandpass filters are coated on 57 mm x 10 mm x 0.7 mm quartz substrates and are available as loose filters or for mounting into other fixtures. The high-pass and low-pass filters are combined to make adjustable bandpass filters. The adjustable bandpass filters block or pass light from 300-700 nm. Excellent blocking (<0.2%) characteristics and resistance to heat make these filters ideal for spectrally shaping the excitation energy from broadband sources.

$600
custom filters available

Shear Plate Collimation Testers

Our Collimation Testers are lateral-shearing interferometers used to examine and adjust the collimation of laser light, to measure wavefront curvature and to quantify divergence/convergence magnitude. Usable in the 200-2500 nm range, each tester consists of a high-quality optical flat in an anodized aluminum frame. Testers are available with apertures ranging from 10 mm to 200 mm.

$600 (10-mm aperture) up to
$4,800 (200-mm aperture)
custom testers available

CUSTOM

Our expertise in a wide range of applications offers great value to researchers and OEMs seeking a flexible, full-service supplier. We offer applications know-how that few manufacturers can match, making Ocean Optics the go-to company for your custom optics and coatings needs.

Because of our big-picture applications knowledge and our performance standards -- a surface accuracy of λ/10 and a scratch:dig of 10:5 -- we feel sure we can meet most any optical specifications. For shorter lead times, we carry as standard stock items an extensive inventory of glasses, fused silica and filter materials. What's more, our patented optical coating technology is a precise, cost-effective means to integrate a variety of optical thin film coatings into the design of an entire new generation of devices.

Our line of services and tools include a machine shop; grinding, shaping and polishing equipment; bonding, soldering and other assembly services; and numerous testing equipment. And our engineers and expert technicians produce all components and systems while following ISO 9001 guidelines.

High-Precision Optics

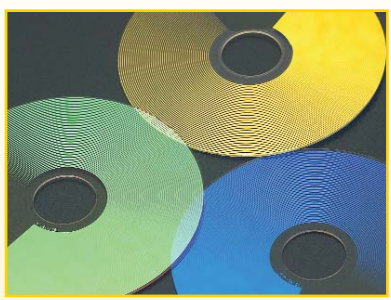
- Beamsplitters
- Collimation Testers
- Laser mirrors and optics
- Filters
- Flats
- Lenses
- Mirrors
- Prisms
- Optical testers
- Spherical shapes
- Windows

Coating Types

- Anti-reflective
- Dichroic, Dielectric, and Interference (UV to NIR)
- Fluorides
- High-reflective
- Metals
- Oxides
- Beamsplitter
- Custom

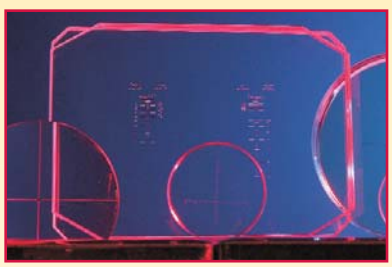
Examples of Custom Products

Variable Saturation Filters



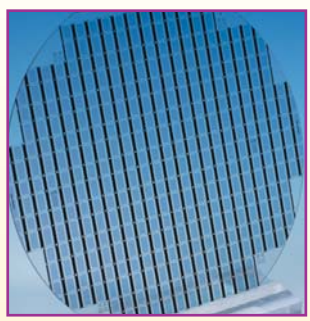
- Available in standard sizes and custom designs
- Excellent optical transmission efficiency for superior brightness
- Temperature and humidity stability for consistent color reproduction
- Used in entertainment, display and lighting fixtures

Reticles



- Used for targeting systems, firearm scopes, and binoculars
- Choose either an etch-and-fill or a dielectic and metallic pattern
- Superior line and image quality
- Etch-and-fill reticles have line widths from 0.005 mm to 0.5 mm
- Specify etch and fill reticles with black, white or red fill
- Direct-view, projection, light-field, dark-field and side-illuminated reticles

Patterned MEMs Windows



- Patterned MEMs Windows on a variety of custom-sized wafers
- Anti-reflective coatings -- with high angles of acceptance -- available in wavelength ranges from 200-2500 nm
- Other types of coatings can be combined on same wafer
- Patterns aligned with great precision on both surfaces of the wafer

CAPABILITIES

At Ocean Optics we take an innovative, customer-oriented approach to meet your needs. Our expertise in electro-optics, spectroscopy, optical fibers and precision optics offers great value to researchers and OEMs seeking a flexible, full-service supplier of military- and commercial-quality optical systems. We offer a range of skills, techniques and services to provide you with state-of-the-art, one-stop-shopping optical manufacturing.

Since all grinding, polishing, coating and assembly operations are performed in-house, we have absolute quality control over the entire process, whether it be for prototype or production optics. Our modern facility houses advanced manufacturing and assembly equipment operated by highly skilled personnel working around the clock. A network of new high-speed CNC machines, double-sided polishers, and a wealth of precision optical manufacturing experienced geared to ISO 9001 quality standards will ensure on-time and on-quality performance.

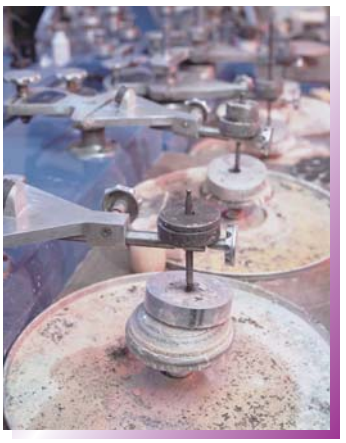
Raw Materials

We select only top-grade materials for machining into the optical component you need for your application. Options include:

Optical glasses
- Borosilicate glass
- Fused quartz

Low-expansion glass
- Zerodur
- ULE

Ceramics
- Zerodur



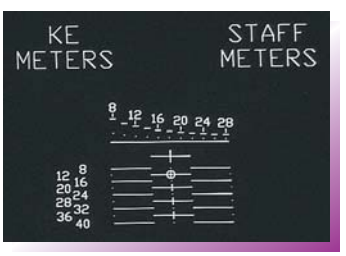
Machining and Finishing

Our full-size machine shop creates metal components and assemblies with equipment such as CNCs and lathes, as well as numerous conventional machine shop devices and tools.

Our optics refining capabilities -- double-side grinding, cutting and polishing equipment for plano and spherical optics -- can handle raw materials up to 200 mm in diameter or 220 mm in length.

Etching

Our etch-and-fill reticles can be fabricated with line widths from 0.005 mm to 0.5 mm. Etchings are available with black, white or red fill. At right is a close-up of a 0.015 mm line-width etching on one of our reticles for the military.



Assembly

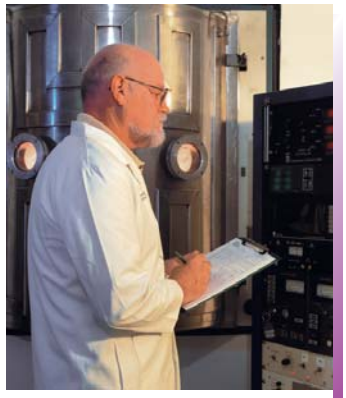
With in-house machining capabilities, as well as more than a decade of electo-optic experience, we provide a wide range of assembly services.

Assembly Production
- Optical cementing
- Soldering and wiring
- Thin film and surface mounting
- Thin film bonding
- Opto-mechanical

Coating & Microlithography

Our sophisticated and patented optical coating technology combines optical thin film deposition techniques with microlithographic procedures to provide a variety of precise, cost-effective, optical thin film coatings.

This high-precision patterning can be applied to whatever filtering configuration the customer requests, and provides color filtering, spatial resolution, transmission efficiency and durability that's superior to dye-colored gels and other commonly used filtering technologies. All of the coatings listed below can be deposited onto optical substrates using this patented process.



Coating Types

- Anti-reflective
- Fluorides
- High-reflective
- Metals
- Dichroic, Dielectric, and Interference (UV to NIR)
- Oxides
- Beamsplitter
- Custom

QC Standards

Our standards program adheres to ISO 9001 guidelines and strict quality control flows and procedures.

Standards

- Clean-room environment and production
- Military compliance (MI-PRF-13830)
- Receiving inspections
- Extensive QC testing
- SPC and TQM manufacturing
- Real-time document control process travelers

QC Testing

We perform optical-surface, spectral, environmental and mechanical testing on all products to ensure the highest quality. Our full-service metrology department accurately measures and characterizes any characteristic the user specifies.

Test Equipment

- Abrasion
- Adhesion
- Alignment telescopes
- Collimators
- Environmental
- Interferometers
- Radius bench
- Spectrophotometers

SPECIFICATIONS

Optics Performance

Curvature:
plano, concave, convex

Deviation/wedge:
<0.002 mm

Wavefront:
<1/20 wave

Flatness:
λ/10 at 633 nm

Irregularity:
<1/10 wave

Mechanical tolerance:
<0.010 mm

Parallelism:
<30 arc seconds

Surface quality:
better than <10-5

Surface roughness:
<10 angstrom RMS

Size of finished optic:
1 mm to 200 mm

Coatings Performance

Substrates:
up to 455 mm diameter

Image size:
up to 250 mm square

Pattern resolution:
to 2 µm features

Spatial resolution:
to 1 µm

Bandwidth:
0.2-2.5 µm

Temperature tolerance:
-80 °F to 700 °F

Coating wavelength range:
200-2500 nm

Coatings used in patterning:
see coating types at left