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Photop Optics is a recognized leader in the manufacture and supply of Crystals, Fiber optics, Precision optics, and Optical assemblies for industrial and commercial applications.

Our global manufacture footprint consist of advanced coating center in Santa Rosa, quick-turn service center in Florida, comprehensive manufacture capabilities in Fuzhou, and high volume manufacturing factory in Vietnam. Photop Optics further extends its capability and capacity for high energy laser crystals and optics for industrial laser; precision and high reliability filters and optics for life science and instrumentations, and cost competitive optics for telecommunications and consumers.

Inspired by our entrepreneurial culture, Photop Optics is creating great value to our customers. Our mission is to grow and open up new opportunities to pursue excellent achievement with our customers in support of quality products and total solutions.

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**Etalon**

An etalon is an optical interferometer in which a beam of light undergoes multiple reflections between two reflecting surfaces, and whose resulting optical transmission (or reflection) is periodic in wavelength. Actually it works as a narrowband filter. Etalons can be used as precise wavelength references in telecommunication applications where the periodicity of the signal provides an array of reference frequencies for the telecommunications grid. When used with active feedback electronics, etalons form the basis of wavelength locking systems that can be used to stabilize the wavelength of a laser.

**Features**
- High Precision FSR Tolerance: +/-0.001GHz
- Nano-Precise Thickness Tolerance Control: +/-1nm
- Optical Contact Available upon Request
- High Damage Threshold & Great Thermal Stability
- Telcordia Compliant

**Principle of Etalon**

The Finesse ($F$) is given by:

$$F = \frac{\pi \cdot (R_1 \cdot R_2)^{14}}{1 - R_1 \cdot R_2}$$

The factor affects finesse is the reflectivity of the mirrors, surface figure and parallelism.

$$\text{FWHM} = \frac{\text{FSR}}{F \cdot \text{Finesse}} \text{ in Hz}$$

**Photop offers** Air-space, Solid and Multi Cavities Etalons. These Etalons have been supplied to leading customers in telecommunications and applied to:

- Interleaver
- Wavelength Locker
- Tunable Laser / Filter
- Dispersion Compensation Component
- High-End Transmitter / Transceiver

**Prism High Reflective Mirror**

Prisms and Mirrors are common and necessary components to deflect beam to optimize optical path and get compact module structure and size, they are widely used in WSS, Tunable Laser, 10/40G components / modules.

**Features**
- Can be used at any incidence angle for AR/PR/HR coatings over 0-70 deg
- Broadband Thin Film Dielectrics and Metal High Reflective Coating
- Low Dispersion
- Excellent Surface Flatness & Perpendicular
- Good Coating Durability

**Prism**

- Various Optical Material: BK7, synthetic fused silica, SF11 or customer specified glass
- Manufacturing capabilities include Right Angle, Dove, Penta, Roof, Rhomboid and Micro Wedge Prisms with optional size from 0.5mm to 50mm
- Custom Prisms with angle tolerance < 30 arc sec
- AR, PR, HR coating are available at S, C and L band with optional incidence angle over 0-70deg
- Typical Surface Flatness: $\lambda/4$
- R > 99.9% for various incidence angle over 0-70 deg
- Up to $\lambda/10$ flatness
- Up to 20/10 surface quality
- Optical glass and fused silica from different sources
- Low PDL < 0.05 dB (Typical)
- Good Coating Durability
- Typical Surface Flatness: $\lambda/4$
Polarization Optics are widely used in Laser and Instrument applications, and Telecom Modules like Interleavers, Circulators, Tunable Lasers, PON components and WSS etc.

Photop offers a full series of Polarization management products:

- Polarization Beam Splitter
- Non-Polarization Beam Splitter
- Waveplate Series (Multiple, Zero, Achromatic)
- Birefringence Crystals (YVO4 & LiNbO3)
- Polarization Rotator

Features:
- Ideal in Tunable Laser, Interleaver, 90 deg Hybrid Modules
- Polarizing, Non-polarizing, Cube, Plate are available with various sizes
- Optional T/R ratio for random polarization
- High Extinction Ratio better than 1000:1

Waveplates:
- Epoxy-free Waveplates and Assemblies
- True Zero Order, Low Order, Multi Order, Achromatic, Dual Wavelength Waveplates
- Retardation Tolerance up to 1/1000
- Transmitted Wavefront 1/10
- Volume Capacity > 100,000 pcs/month
- Sizes from 0.5mm to 100mm

Birefringence Crystals - YVO4 / LiNbO3
- Widely used in WSS, Interleaver, Isolators, Circulators, OCM etc.
- Beam Displacer, Wedge, PBC core, C-polarizer are available with YVO4 and LN material
- Wavefront Distortion better than 1/4
- Various Size from 0.5mm to 40mm
- Surface Quality better than 10-5 S/D
- O. A. Orientation Tolerance: +/- 0.1 deg

High Precision Lens

Photop Optics provides lenses with a wide range of sizes and materials including BK7, Fused Silica, and any other glass types specified by our customers. Lenses are widely used in WSS components and test instruments, they are classified as singlet lenses, cylindrical lenses and achromatic lenses according to their different applications.

Features:
- Rectangular Lens for mounting are available with various sizes and glass materials depend on customer specifications
- Optical Bonding for Achromatic Lens Assemblies
- Automatic Polishing Technology
- High Precision Metrology
- Zygo + CGH test system
- Trioptics Test System
- Nikon high precision microscope

Capabilities:
- Various Rectangular Lens size specified by customers
- Various glass material are available from Ohara, Schott and other sources
- Flatness up to 1/8
- Surface Quality better than 10-5 S/D
- Centration < 3 arc min
Micro optics are suitable for fiber optics communication and can be used in passive, FTTx components for fiber collimating, fiber coupling and fiber transmission, which includes fiber collimators, isolators, WDMs, switches and PON components etc.

### Micro Lens
- **Type:** G-lens, C-lens, D-lens, Ball Lens
- **Diameter:** > 1.0mm (Typical: 1.0mm, 1.8mm, 2.5mm)
- **Wedge Angle Tolerance:** +/-0.5 deg
- **Coating:** AR (Typical: R<0.25%@1260-1620nm) Tap Coating (Typical tap ratio: 1%, 2%, 3%, 5%, 10%)

### Fiber Pigtail
- Single Fiber, Dual-Fibers, Three-Fibers, Four-Fiber Pigtails are available with various fiber types including SMF, PM, H1060, Colored Fibers etc.
- **Typical Diameter:** 1.0mm, 1.8mm
- **Surface Quality:** 0-0 at fiber core
- **AB, PR, HR coating are available at S, C and L band**
- **PM Fiber Pigtail with ER >26dB**

### Fiber Lens
- Unique Polishing Technology
- Direct Fiber-end Spherical Lenses
- High Laser Damage Threshold Coating

FTTx & WDM Filters

Equipped with advanced coating machines like OPTORUN, Leybold, and high power electron gun and plasma IAD system, our coating center in Guangzhou focuses on high quality optical filters (WDM, FTTx, etc.) for telecommunications, and wide variety of dielectric interference filters (IR-cut).

### Applications
- G-EPON
- LTE
- BIDI
- Diplex & Triplexer
- Cable TV PON

### FTTx Filter
- 10G G-EPON (OLT) Filter
- 10G G-EPON (ONU) Filter
- LTE Filter
- BIDI Filter
- 10G BIDI Filter
- Diplex Filter
- Triplexer Filter

### WDM Filter
- Bandpass Filter
- EDGE Filter
- CWDM Filter
- DHWM Filter

### Features
- Low Insertion Loss
- Small Ripple
- High Isolation
**Industrial / Medical Laser Application**

With the advanced crystal growth technologies in Florida, USA and Fuzhou, China, Photop Optics has strong expertise on crystal and laser optics processing, state-of-the-art thin film coating, and precision assemblies. With great support of our engineering team, Photop Optics provides high quality laser gain crystals, NLO crystals, high energy laser optics, high reliability components and precision subassemblies for Industrial Laser and Medical Laser Applications.

**Laser Gain Crystals**
Nd Doped YAG and YVO4 crystals used in solid state 1u lasers which are major tools for welding, cutting, drilling, marking, engraving. Er Doped YAG crystals @ 2.94μ are used in medical lasers for aesthetic and dental applications. Undoped YAG crystals, polished to high quality laser finish, is ideal hard material for optical components such as mirrors and prisms. Nd:YAG has laser opportunities @ 532, 355, 266, and 213 nm. Photop is a world leader in the supply of high quality YAG and YVO4.

**Key Products**
- YAG (Nd, Er, Cr,Tm:Ho)
- YLF (Nd, Er, Tr, Ho, Pr, undoped)
- YVO4 (Nd)
- LiSAF (Cr, Ce, Ce:Na)
- Ruby
- YALO, YAP (Nd, Tm)

**Nonlinear Optics Crystals**
The frequency conversion process is used for laser application to convert laser wavelength range, which include frequency doubling or second harmonic generation (SHG), sum frequency generation (SFG), differential frequency generation (DFG), and optical parametric generation (OPG). The nonlinear optical (NLO) crystal is the medium used for the frequency conversion for lasers. With more than 10 years of crystal growth experience, Photop Optics provides major NLO crystals of KTP, BBO, LBO, LiNbO3.

**Key Products**
- KTP
- BBO
- LBO
- KNbO3
- LiNbO3

**Monolithic Bonded Chips**
With the unique diffusion bonding technologies, Photop Optics provides monolithic functional chips which bond different crystals for different applications.

**Key Products**
- Nd:YVO4 & KTP Green Laser Core
- YVO4 & Nd:YVO4 High Power Gain Chip
- Nd:YAG, Cr:YAG & undoped YAG Passive Q-Switch Chip

**Debris Shield Windows**
Laser Debris Shields (DS) protect lenses from back splatter. For industrial applications, DS windows protect Nd:YAG lasers from harsh manufacturing operations in factories. Photop is a recognized world leader in low cost manufacturing with globalized supply chain inventory management at multiple world locations and rapid turn volume of all standard windows. Photop high quality windows have longer lifetime in production environment.

**Features**
- Diameter: 5 to 140 mm
- Extensive inventory for Industrial and Medical applications
- Material: Fused Silica, Fused Quartz, Sapphire and N-BK7
- High LIDT Coatings for AR, Dual-AR, Triple-AR from 250 to 3000 nm

**Laser Cavities**
Samarium glass cavities are used to filter out unwanted UV laser light that causes solarization in YAG laser. Photop is a recognized world leader in manufacturing of glass laser cavities, with special hardening process on all Samarium glass cavities for rugged use in solid state laser systems, low cost manufacturing center in Vietnam, and the globalized supply chain inventory management at multiple world locations.

**Features**
- Single-Hole and Multi-Hole Cavities
- Standard materials include
  - $7010N (10% Samarium doped silicate glass)
  - $7005 (5% Samarium doped silicate glass)
  - $7000 (Cerium doped silicate glass)
  - Fused Silica
  - Pyrex

**Monolithic Bonded Chips**

**Debris Shield Windows**

**Laser Cavities**

**Mirrors**

**High Energy Laser Optics**
For high power laser application, high laser induced damage threshold (LIDT) optical components are required. Combined with internal super polishing capabilities, high LIDT coating, and reliable diffusion bonding technology, Photop Optics provides a wide variety of products for high power lasers covering wavelength range from NIR, VIS and UV range down to 213 nm.
Life Science Application - Components

Life Sciences applications require a wide variety of high-performance optical components, with advanced fabrication and assembly capabilities in Fuzhou, and state-of-the-art coating technologies and capabilities all over the world. Photop Optics provides high-performance flat, spherical, filter, flow cell and subassemblies to guide, reflect, select and alter light to integrate into the life science applications.

Features
- In-house precision micro lenses processing
- Precision bonding assembly
- High reliability

Applications
- Flow Cytometry and Hematology Analyzer
- Fluorescence Microscopy
- DNA Sequencing
- Diagnostics

Filters
Optical filters selectively transmit light in a particular range of wavelengths by blocking the remainder, passing the long or short wavelengths only or a band of wavelengths, or blocking both longer and shorter wavelengths (bandpass). With our unique IBS and ML coating technologies, Photop Optics provides reliable filters with high performance, such as OD6 filters, Linear filters, Notch filters and others.

Features
- High performance OD 6 filters
- Capabilities for single-band, dual-band and triple-band
- Linear filters and Notch filters
- High coating reliability and resistance

Applications
- Flow Cytometry and Hematology Analyzer
- Fluorescence Microscopy
- DNA Sequencing
- Diagnostics

Flow Cell
Photop Optics engineering team develops a unique process to provide high reliability and high-performance Flow Cell products for Flow Cytometry, Hematology Analysis and other systems. With our precision optical CNC processing, we offer different types of flow cells with different shapes, cuvette dimensions, and cuvette size.

Features
- Unique Bonding technology
- Precision cuvette dimensions
- Single cell or multi-cell capabilities
- Flexible cuvette size
- High reliability

Applications
- Flow Cytometry and Hematology Analyzer
- Fluorescence Microscopy
- DNA Sequencing
- Diagnostics

Objective Lens for Diagnostics
The Objective Lens is the optical element that gathers light from the object being observed and focuses the light rays to produce a real image, and Objective Lens can be a single lens or combinations of several optical elements. Photop Optics designs, fabricates and assembles the Objective Lens with high performance.

Features
- Strong optical and mechanical design team
- From Design to Prototype and Mass production
- Precision assembly capabilities with on-time test stations

Rod Lens Assembly for Endoscope
The solid Endoscope needs several high-performance lenses assembled together to transmit the image. Photop Optics provides different types of Rod Lens Assembly products for the Endoscope to transmit images. Please contact our sales department to get more information.

Features
- In-house precision micro lenses processing
- Precision bonding assembly
- High reliability

Applications
- Flow Cytometry and Hematology Analyzer
- Fluorescence Microscopy
- DNA Sequencing
- Diagnostics

Rod Lens

Precision Assembly
- Optical Design Capability
The Optical Design Capability includes both lens and mechanical design, simulation and development processes. Our NPI team is experienced in designs ranging from laser beam expanders, scanning lenses, laser projection and UV objective lenses to long range surveillance lenses. The tools used are Zemax and Solidworks for optical and opto-mechanical designs.

- Assembly & Test Capability
Together with the precision processing capability, our NPI also has an expert team for optical assembly and opto-mechanical assembly. To guarantee the good assembly performance, our NPI engineering team designs and optimizes the test setup based on our metrology platform.

Features
- Unique bonding technology
- Precision cuvette dimensions
- Single cell or multi-cell capabilities
- Flexible cuvette size
- High reliability

Applications
- Flow Cytometry and Hematology Analyzer
- Fluorescence Microscopy
- DNA Sequencing
- Diagnostics
Combining our world-wide capabilities of Optical Processing, Thin-film Coating and Precision Assembly, Photop Optics is providing extensive solutions for Medical Laser systems and Bio-medical devices like analytic and diagnostic instruments.

**Solution for Medical Lasers**

**Key Products**
- Crystals: YAG, YLF, YVO4, BBO, LiO
- Medical Debris Shield Windows
- Laser Cavities
- Waveplates
- High Energy Laser Optics

**Applications**
- Aesthetic Lasers
- Surgical Lasers
- Ophthalmic Lasers (LASIK, Cataract)

**Features**
- Crystal solutions for solid state lasers
- Optical solutions for solid state, gas, diode and fiber lasers
- Wavelength range from UV to NIR
- Laser grade surface finish with 10-5 S/D or better
- High laser damage threshold thin film coating

**Solution for Bio-Medical Devices**

**Key Products**
- Flow Cell and Assemblies
- Filters and Filter Assemblies
- Objective Lens
- Laser Source
- Fiber Coupled Collimators
- Other Optical Components

**Applications**
- Flow Cytometry
- Hematology Analyzer
- DNA Sequency
- OCT

**Features**
- High reliability components
- Precision opto-mechanical assemblies
- Diffusion bonding to achieve high precision and durable optical assemblies
- Strong engineering team support from components to subassemblies
Photop Optics provides a wide variety of optical components, optical mechanical assemblies and customized optics for different instruments. In addition, our NPI engineering team is experienced in working together with customers from Design to Prototype and Production.

Optics for Spectroscopy
Integrated with our Laser products and wide variety of optical components, Photop provides the optical solution for Spectroscopy. Combining our extensive design and engineering capabilities and competitive advantages from integrated manufacturing capabilities and internal supply chain, we provide OEM and ODM service to world leading customers.

Key Products
- Diffractive Gratings
- High Performance Filters
- Bare Metal Mirrors
- Lenses and Other Components
- Narrow Linewidth Lasers

Optics for Machine Vision
Consolidating our NPI and production engineering team, Photop Optics designs and manufactures a wide range of optics and opto-mechanical sub-assembly solutions for machine vision, imaging, measuring, and inspection applications. With our strong optical design capability, precision manufacture processing and strict quality control system, we are experienced to develop and support your requirement for different applications.

Key Products
- Lens and Assemblies
- Precision Customized Prisms
- Polarization Components
- Filters

Optics for Display
Based on our NPI and micro-optics technologies, Photop Optics is providing various optical products for consumer and industrial applications, which include dichroic filters, LED extracting lens, solid light pipe and related assembly for Pico projector light engine, LED light source modules, and automobile and solar products.

Applications
- Light Engine Optics
- LED Light Source Modules
- Water Based Optics
- Automobile Optics

Optics for Surveying
Integrated with our Green Laser products in our laser group, Photop provides the total solution for Surveying and Construction Instruments like Auto Levels, Rotating Laser, and Total Station. Our key products include Green Lasers as the laser source, lenses to shape and collimate the beam, prisms to deflect the beam or rotate the image, and windows and assemblies.

Key Products
- Penta Prisms
- Lenses
- Retroreflectors
- Right Angle, Dove Prisms
- Windows and Assemblies

Optics for Instrumentation
Based on our NPI and micro-optics technologies, Photop Optics is providing various optical products for consumer and industrial applications, which include dichroic filters, LED extracting lens, solid light pipe and related assembly for Pico projector light engine, LED light source modules, and automobile and solar products.

Applications
- Light Engine Optics
- LED Light Source Modules
- Water Based Optics
- Automobile Optics
In support of our products for different applications, Photop has invested a world class coating and metrology facility, which includes Vecco IBS, Leybold and Optorun IAD/EB, internally-designed MS, and other domestic coating machine. Teamed with the coating engineers in Fuzhou, Guangzhou, Santa Rosa, and Florida, Photop can provide anti-reflective, high reflective, partial reflective, mirror, beam splitter, and filter coatings for applications including Telecom, Industrial Laser, Life Science and Instrumentation with wavelength range from deep UV to NIR.

**Advance Coating Center**

With all advanced coating chambers, state-of-art technologies and experienced coating engineering teams, Photop coating center provides a wide variety of coating services.

- Standard AR, HR, Mirror, PBS coating
- Deep UV coating
- High-end Filter coating
- High-end Non-Polarization Beamsplitter (NPBS) coating
- High Energy Laser Optical coating for wavelength range of UV to NIR

**IAD / EB Coating Technologies**

Ion-assisted deposition (IAD) is the technique that while the film is being deposited, one beam of ions bombard the substrate. EB is the electron beam gun deposition technique. Compare to IBS and MS technologies, IAD/EB coating is less stress, low absorption and less dense, but suitable for high volume production.

**IBS Coating Technology**

Ion-beam sputtering (IBS) is a method that atoms of materials are bombarded and deposited on the substrate by impact of ions. The second ion source is used to bombard the substrate when the sputtered atoms are deposited on the substrate. IBS makes coating film very dense, very low pinholes, low absorption, increases the adhesion and humidity resistance of films, to make a reliable hard coating.

**MS Coating Technology**

Start the essential components of Magnetron control sputtering (MS) is a cathode and an anode, between which an electric field is established that produces a specific power density. Similar to IBS, MS can make very good quality hard coatings. It was because the sputtered atoms has the energy of a few keV level even with no second source assisted. Photop Santa Rosa Coating Center is equipped with advanced MS coating machines.

**New Product Introduction (NPI)**

For our Vertically Integrated Solution strategy and better support to our customers, Photop Optics NPI team work closely together with our customers from design to prototype and volume production. Our NPI production line is equipped with most advanced processing equipment include MRF precision processing machine, large size Planetary Polishing stations, Photolithography processing and advanced metrology equipment, like large aperture ZYGO interferometers, AFM, and engineered performance setups.

**MRF**

Magnetorheological Finishing (MRF®) provides the control of finishing processes and bottom line. This patented, deterministic process combines magnetorheological fluid - a unique, magnetically-sensitive (or magnetorheological) material - with sophisticated computer algorithms. It has the unique ability to improve figure and finish simultaneously. Flexible and fast, stable and accurate - MRF does it all. You'll get predictable and precise results every time.

Photop Optics’ MRF machine enhances our conventional polishing capabilities to achieve higher level products quality and repeatability. The surface finish could achieve better than Lambda/50 and surface roughness better than 0.2 nm.

**Optics Assembly**

Based on our strong Design and Package technologies by our NPI team, and utilizing our unique technology platforms of Optical Contact, Diffusion Bonding, and Seam Sealing, Photop specializes in high reliable opto-opto and opto-mechanical assemblies which enable a wide variety of integration for different instrumentation applications.

**Test Center**

Photop quality control and measurement processes play a very important role in the manufacture of our products. As a key to our commitment of Total Quality Management, Photop Test Center has a complete testing solution on specification and reliability to guarantee our product quality.
New Products
Clarity Filters and Gratings

Complying with our technology roadmap, our R&D and Engineering teams put strong efforts to develop new products and capabilities to support customers and expand our product portfolio. The most highlighted products which we developed in past years with superior performance include Clarity Filters and Diffraction Gratings.

Clarity Filters
Located in Santa Rosa, CA, our Advanced Coating Center (ACC) expertise in filter design has allowed Clarity Filters to be integrated into many Bio-instruments including 510K approved systems that require the highest performance standards while operating in tough environments. As a result, Clarity Filters have been incorporated into Flow Cytometers, real time PCR systems, and numerous other biomedical instruments used in clinical diagnostic labs, large pharmaceuticals, and R&D labs around the world.

Applications
- Real Time PCR
- Flow Cytometry
- DNA Sequency
- Cancer Detection
- Fluorescence Microscopy

Features
- Minimizing Crosstalk, Maximizing Signal
- Advanced Energetic Deposition (AED) Coating Technology
- High Transmission and Blocking
- Very Steep Edges
- Lower Scatter
- Durability in Demanding Environments
- LIFE-TIME WARRANTY

Graph showing optical density and wavelength.

Diffraction Gratings
A diffraction grating is an optical component with a periodic structure, which splits and diffracts light into several beams traveling in different directions in order of wavelength. With our developed processing of Holography, Ion-etching and Replication, Photop Optics provides Piano and Concave reflection gratings and Piano transmission gratings according to customer’s applications.

Applications
- Optical Spectroscopy
- Chemistry Analyzer
- Optical Coherence Tomography (OCT)
- Telecom Applications like WSS, OCM, OSA
- Laser Pulse Compression
- Laser Beam Combination

Features
- High Diffraction Efficiency
- High Laser Damage Threshold
- Low Stray Light
- High Reliability

Capabilities
- Aluminum/Gold/Silver/Dielectric/AR Coating
- Volume & Precision Grating Fabrication and Replication
- Total Quality Control (Efficiency/Wavefront/Stray Light/Laser Damage Test)
Waveplate Store

A waveplate or retarder is an optical device that alters the polarization state of a light wave traveling through it. Photop Optics offers the highest quality Quartz, Sapphire, or MgF2 based waveplates in quarter and half wave, multiple and zero order designs. Standard diameters range from 5 to 50.8 mm and wavelength range from 200 nm to 2 micron.

More than 30,000 waveplates in stock at our Waveplate Store.

Visit the Waveplate Store website to get more detailed information: www.thewaveplatesstore.com

Features

- An inventory of 30,000 waveplates ready for immediate delivery
- Multi Order, Zero Orders, and Dual Wavelength
- Standard Quarter-Wave and Half-Wave with diameter from 5 to 50.8 mm
- Cell mounting available.
- High Damage Threshold Coatings
- Coating wavelength from 250 to 2100nm
- Materials include Quartz, MgF2, Sapphire or specified crystals

Metrology

Photop quality control and measurement processes play a very important role in the manufacture of our products. As a key to our total commitment of Total Quality Management, the Photop metrology center has a complete testing solution to guarantee our products meet the specifications of our customers. Our metrology center is a National Recognized Lab.

Our FQC (final quality control) team works as the Customer Care Center to guarantee the products quality.

PCI-LOW Absorption

Lambda 900 Spectrophotometer

ZYGO New View

AFM (Atom Force Microscope)

ZYGO Interferometer

Ellipsometer