Intane OPTICS® 英田光学

Precision Optical Coating Solution

ONE WORLD CONNECTED WITH LASER

Company profile

Nanjing Intane Optics was founded in 2003 by Professor Zhou Bifang, the former director of Nanjing Astronomical Instruments Research Center, the Chinese Academy of Sciences. Nanjing Intane Optics is a national high-tech enterprise with precision optical systems solutions at its core competency. The company boasts a team of experienced engineers in precision optical engineering, with proven technological capabilities ranging from complex system design, integration, assembly, testing to the manufacturing of key optical components.

Advanced optical elements are the core components that determine the performance of precision optical instruments. As technology and requirements develop, there are increasingly higher demands for the performance of advanced optical elements.

Nanjing Intane Optics is actively engaged in research on ultra-precision optical component processing technology. With internationally advanced polishing and testing equipment, combined with self-developed CNC equipment, our experienced technicians team is constantly taking on challenges of high-performance optical component manufacturing with increasing difficulty. We have achieved full-spectrum nano-scale processing accuracy in the manufacturing of optical aspherics, spheres, planes, cylinders, and windows. Through high-performance optical coating, our products feature long life, high reliability, high strength, and diversity of optical components.

Based on high-precision optical components, Intane Optics also has developed a series of high-precision optical testing instruments and equipment. Collimators of various aperture and specifications have a good reputation among customers. Intane Opics: Your trusted supplier for precision optical system solutions.

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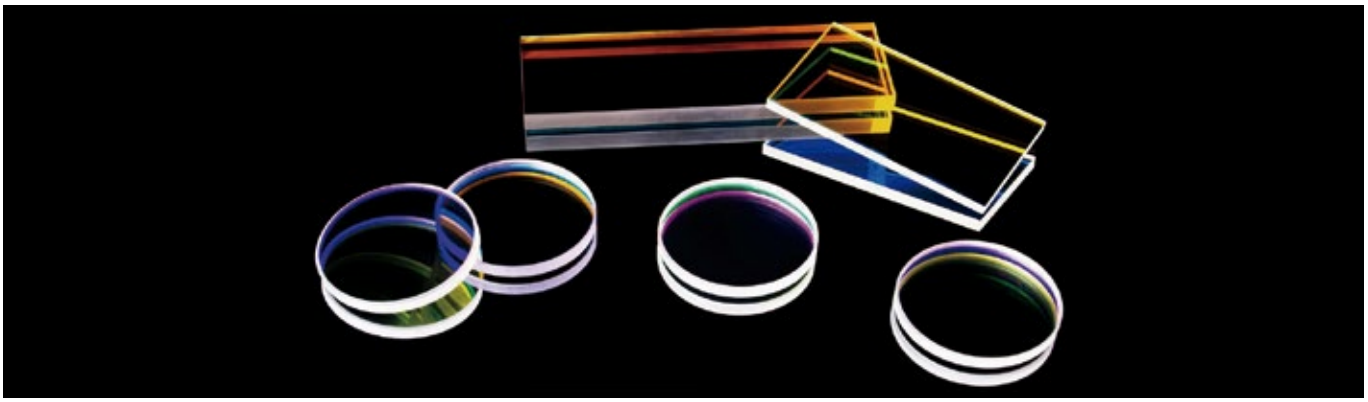
ONE WORLD CONNECT
WITH LASER

Products and application cases



Optical coating is for better transmissivity, reflection or polarization of optical elements. For each uncoated glass device, about 4% incident light on its surface is reflected. Antireflection coatings makes the percent smaller than 0.5%; high-reflecting dielectric coatings improves reflectivity to 99.5% or above. An optical coatings is made up of a thin material such as oxide, metal, or rare earth. Its performance depends on its layers, thickness, and refractive index differences among different layers.

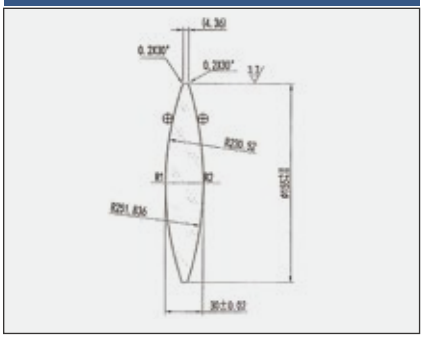
For the highest or lowest interference, the optical thickness of an optical coatings is usually a quarter of optical thickness (QWOT) of wavelength of the light used, or half of optical thickness (HWOT) of wavelength of the light used. Its high refractive index and low refractive index are alternate for the wanted interference effect.

Antireflection film

Application case 1:

Technical requirements: Antireflection coatings is coated on surfaces R1 and R2; the mean transmission in the 900nm to 2500nm wave band is equal to or more than 98% @ 632.8nm; Measured transmission of the antireflection coatings as below .

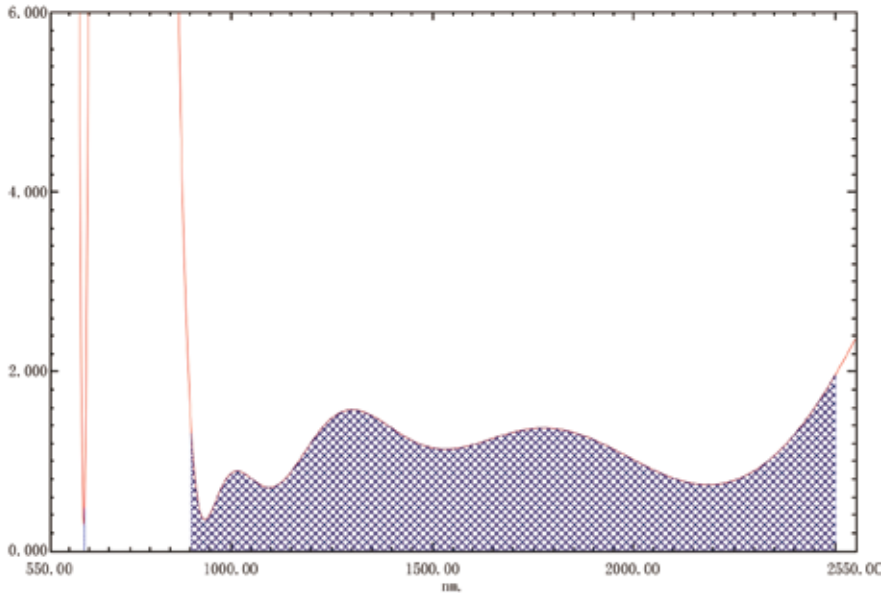
Product dimensions



Quality of optical glass	
Uniformity	H2
Fringe intensity	1C
Birefringence	2
Extent of bubble	1C
Light absorptivity	3

Precision of optical machining		
	R1	R2
Specimen precision △R	A	A
Radius deviation N	3	3
Partial deviation △N	0.3	0.3
Eccentricity c	0.02	0.02
Surface finishment MIL	Ⅲ	Ⅲ
Clear aperture Do	Φ152	Φ152

Spectral peak area report



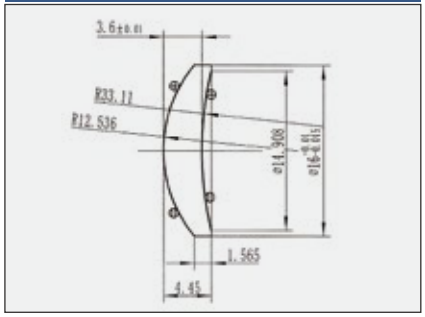
Zone	Color	Begin	End	Divisor	Area	Result	Description
1		633.00	634.00	1.000	0.413	0.413	
2		900.00	2500.00	1600.000	1780.646	1.113	
3							

Application case 2:

Technical requirements:

1. Anti-reflection coatings is coated; the wave band involved in coating is 486nm to 586nm; the single-side transmission is more than 99%.
2. Three layers of protective coatings are coated.
3. Outer coating C04-83 is no more than 0.01mm thick.

Product dimensions



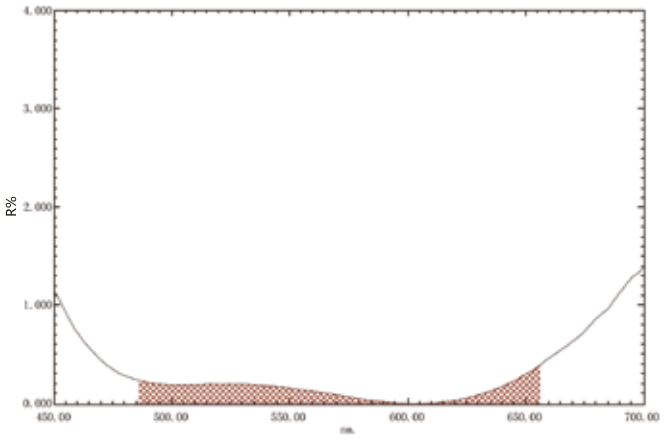
Material requirements

ΔN_d	1A
ΔV_d	1A
Optical uniformity	1
Optical absorptivity	1
Stress birefringence	1a
Fringe intensity	1a
Extent of bubble	1c

Element requirements

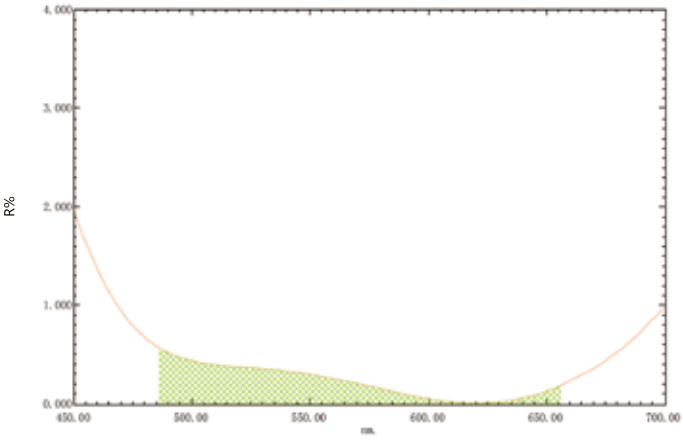
N	1
ΔN	0.1
ΔR	/
X	15''
Do	Φ14.5/Φ15

Spectral Peak Area Report (without Waterproof Coating)



Zone	Color	Begin	End	Divisor	Area	Result	Description
1		486.00	656.00	170.000	22.325	0.131	
2							

Spectral Peak Area Report (with Waterproof Coating)



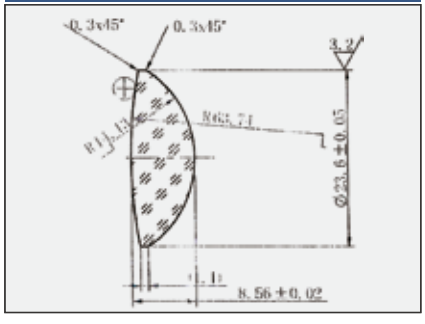
Zone	Color	Begin	End	Divisor	Area	Result	Description
1		486.00	656.00	170.000	37.298	0.219	
2							

Application case 3:

Technical requirements:

1. In the wavelength range of 400nm to 1000nm, the reflectivity R is 1% at most.
2. Trim of the lens is black.

Product dimensions



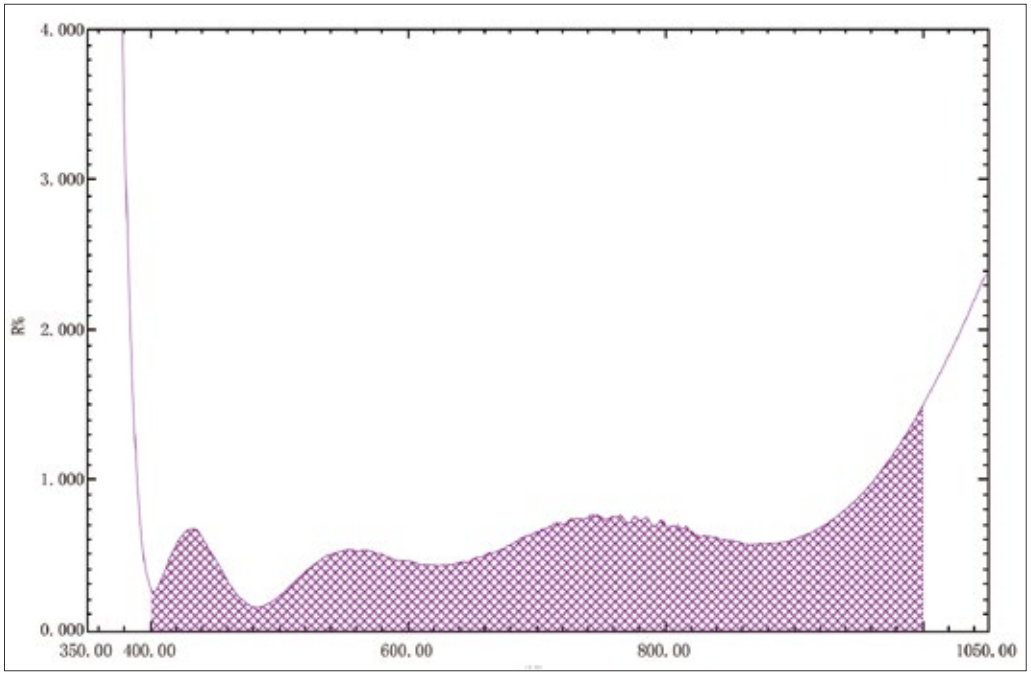
Material requirements

ΔN_d	28
ΔV_d	28
Optical uniformity	3
Optical absorptivity	2
Stress birefringence	2
Fringe intensity	1c
Extent of bubble	1c

Element requirements

N	3
DN	0.3
DR	A
C1	0.02
C2	0.02
B	1V
D_{01}	Φ33
D_{02}	Φ33

Spectral Peak Area Report



Zone	Color	Begin	End	Divisor	Area	Result	Description
1		400.00	1000.00	600.000	361.604	0.603	
2							

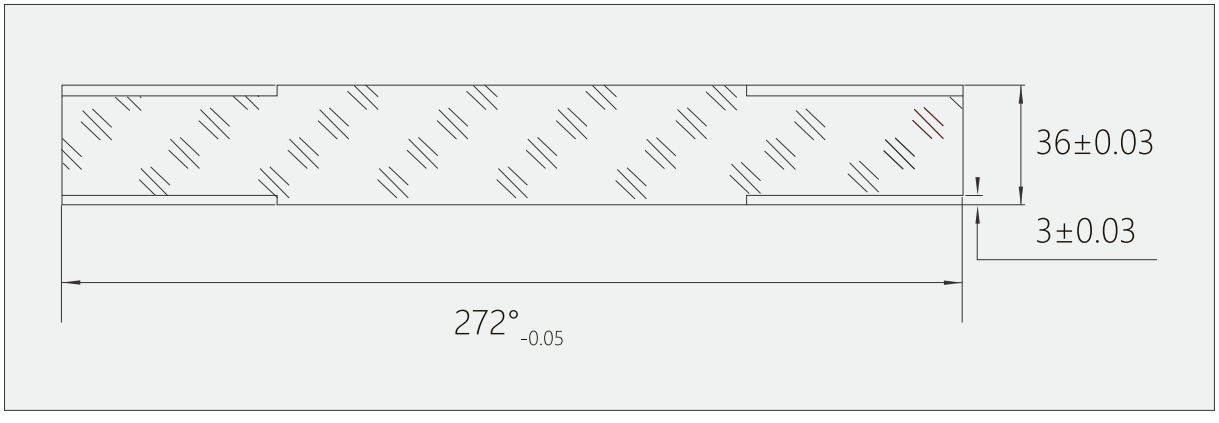
Beam splitting coatings

Application case 1:

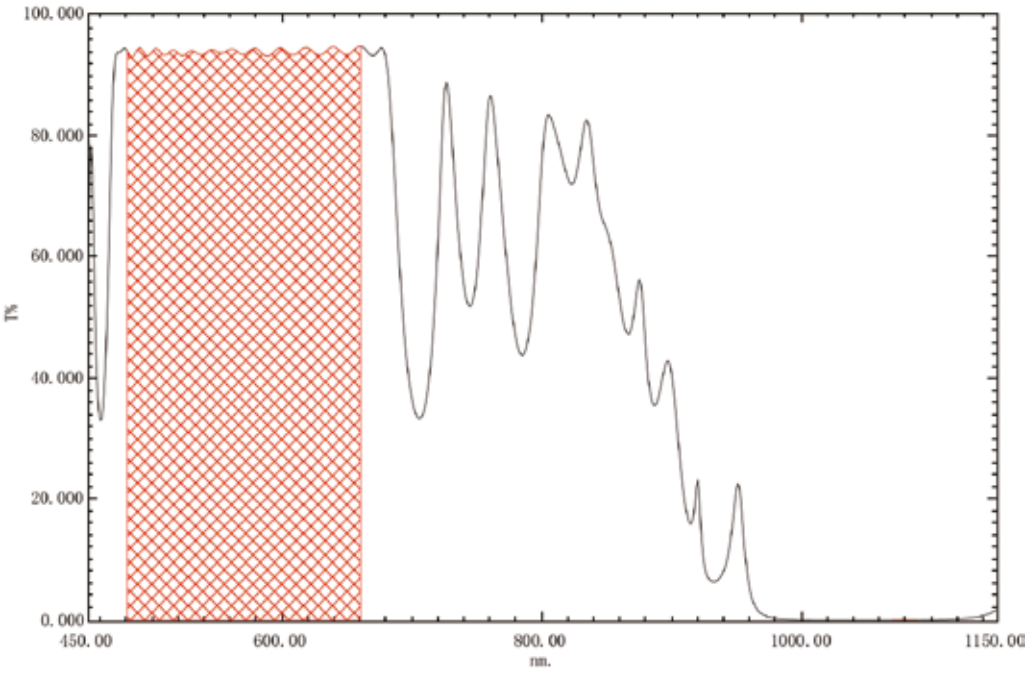
Technical requirements:

1. Spectral beam splitting beam is coated;
2. The angle of incidence is 45° ±1.5° ; the reflectivity R (1.070μm – 1.09μm) is more than 99.5%; the laser damage threshold should be more than 5000W/cm2; the absorptivity in the 1.08μm is less than 0.01%; the average transmissivity in the 480nm to 660nm wave band is more than 90%; the surface accuracy of the coated reflecting surface is better than λ/6 (P-V), λ/40 (RMS); the test wavelength is 632.8nm.
3. The power density is 5000W/cm^2.

Product dimensions

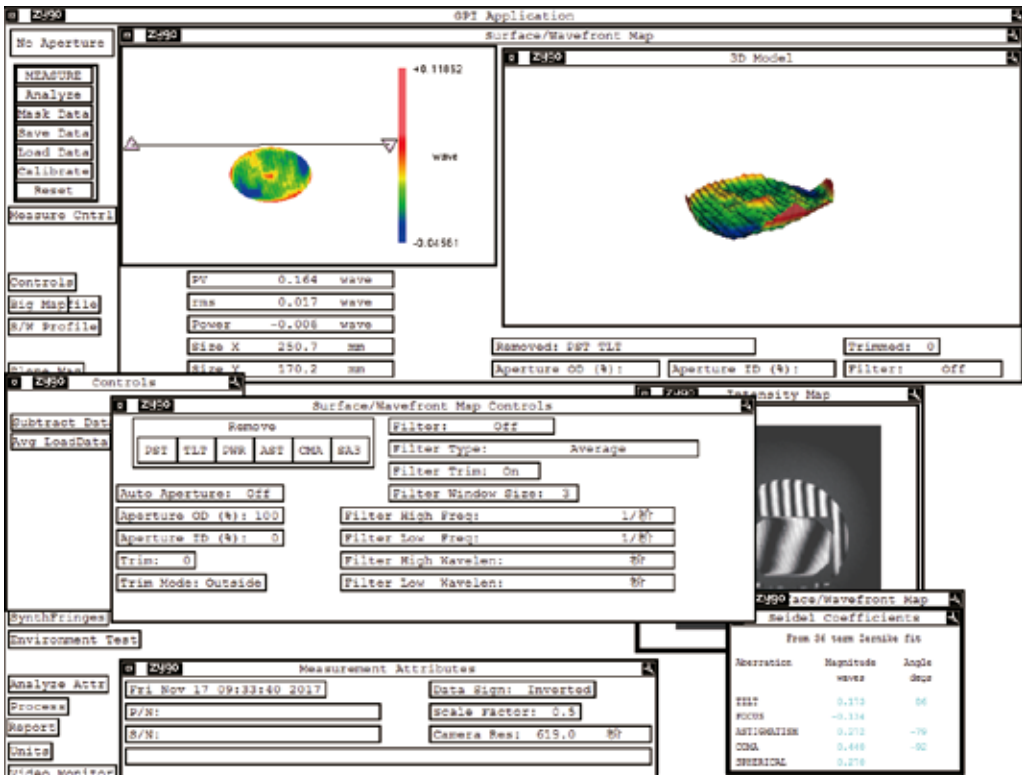


Spectral Peak Area Report



Zone	Color	Begin	End	Divisor	Area	Result	Description
1		480.00	660.00	180.000	16870.889	93.727	
2		1070.00	1090.00	20.000	0.936	0.047	
3							

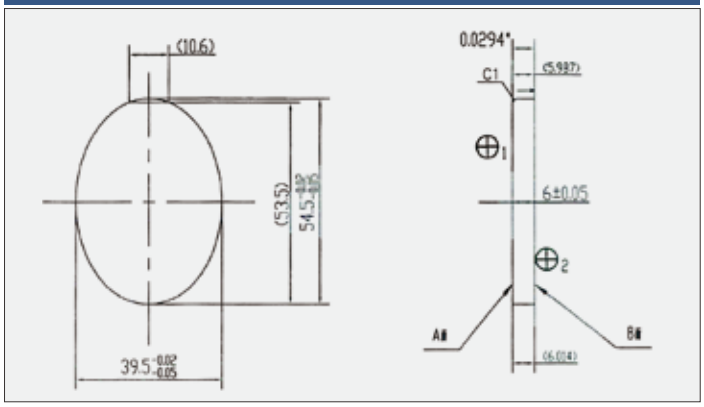
Coated surface flatness



Application case 2:

1. Precision requirement for wedge angle: <12″
2. 3.7um to 4.8um AR film is coated on⊕$_1$; the average transmissivity of surfaces A and B is 94%.
Beam splitting film is coated on⊕$_2$; reflection wave band from 0.43um to 1.6um, and transmission wave band from 3.7um to 4.8um; the average reflectivity of wavebands 0.4um to 0.9um, 1um to 1.6um, 1.064um and 1.57um is 94%.
3. The angle of incidence is 35° to 55°.
4. surface accuracy requirements: Surface A: RMS ≤1/20λ; PV≤1/4λ (reference); λ = 632.8nm, with power; Surface B: RMS ≤1/30 λ; PV≤1/5λ (reference); λ = 632.8nm, with power;
5. Undeclared chamfer C0.3
6. Operating temperature: -50℃~ 60℃

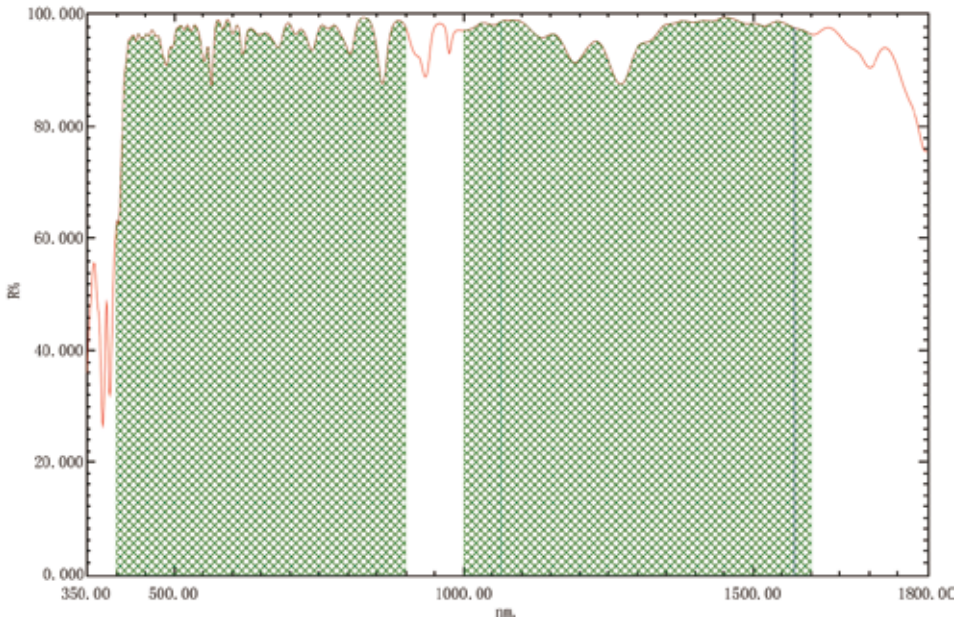
Product dimensions



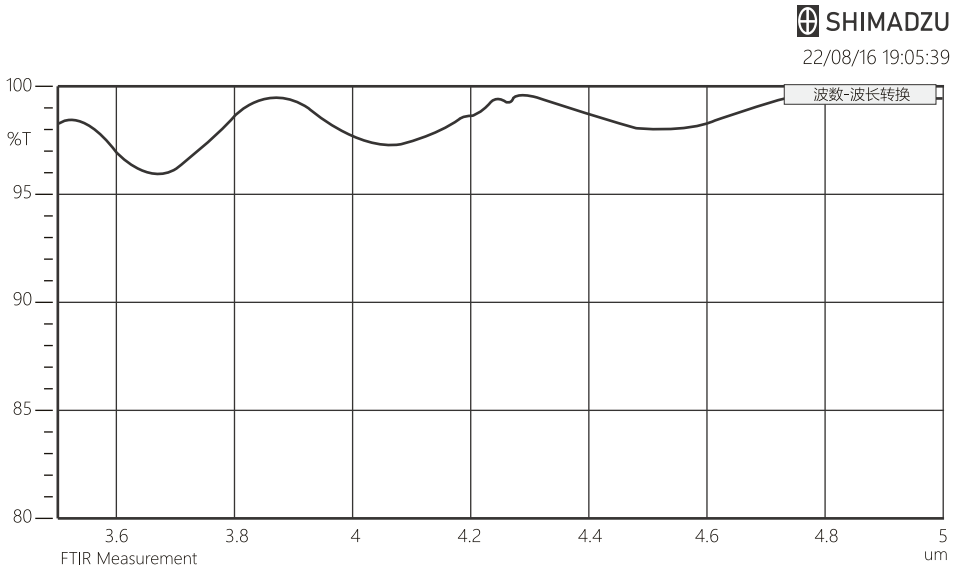
Element requirements

N	/
DN	/
DR	A
C1	/
C2	IV
B	/
D_{01}	47*36
D_{02}	/

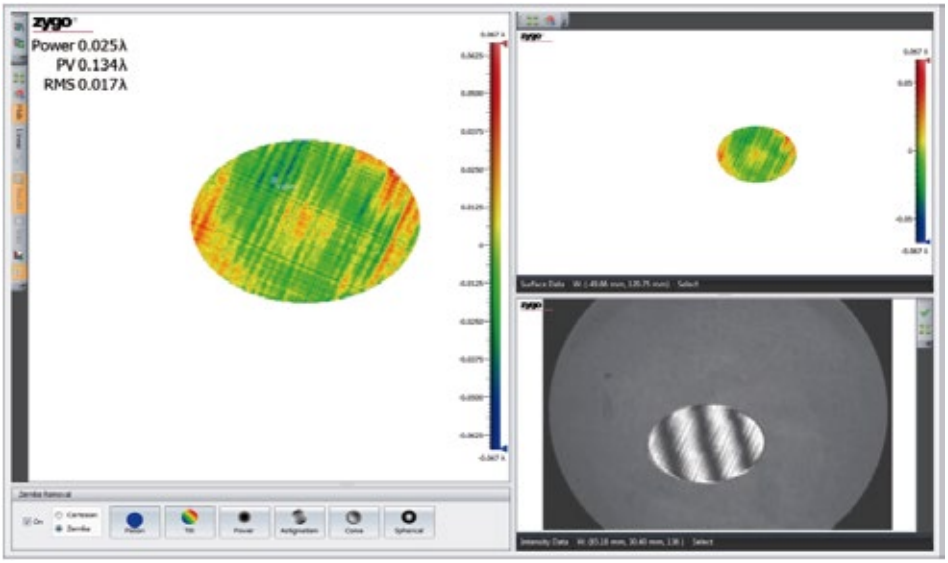
Spectral Peak Area Report

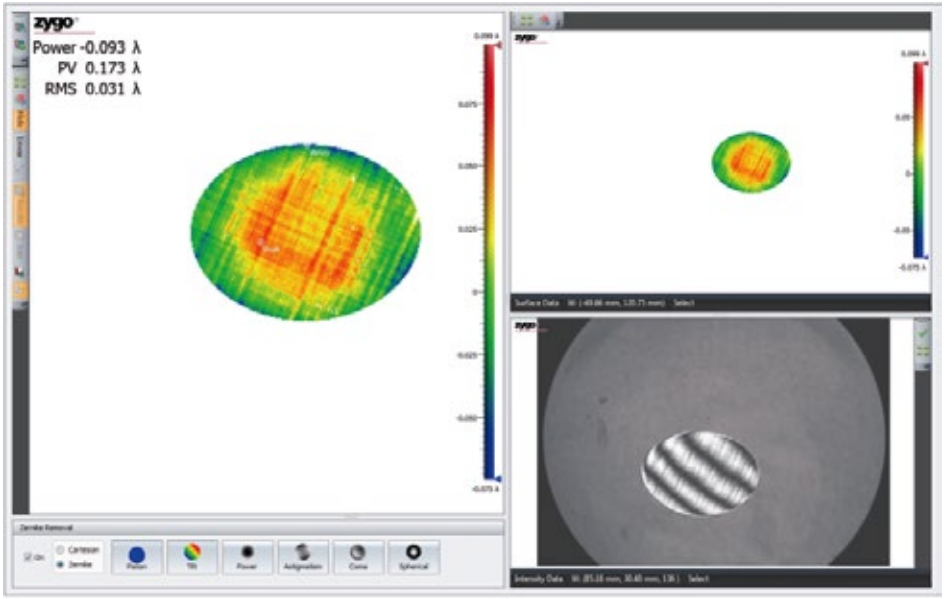


Zone	Color	Begin	End	Divisor	Area	Result	Description
1		400.00	900.00	500.000	47630.835	95.262	
2		1000.00	1600.00	600.000	57910.505	96.518	
3		1064.00	1065.00	1.000	98.579	98.579	
4		1570.00	1571.00	1.000	97.507	97.507	
5							



Coated surface flatness precision





Application case 3:

Technical requirements:

1. Operating wavelength: 522nm ~ 862nm

Anti-reflection coatings: Residual reflectivity: <0.5%; angle of incidence: 0±3°

Internal reflecting coatings: Rp>98%; Rs>98%; angle of incidence: 45±3°

Beam splitting coatings: Tp>95%, Rs>99.5%

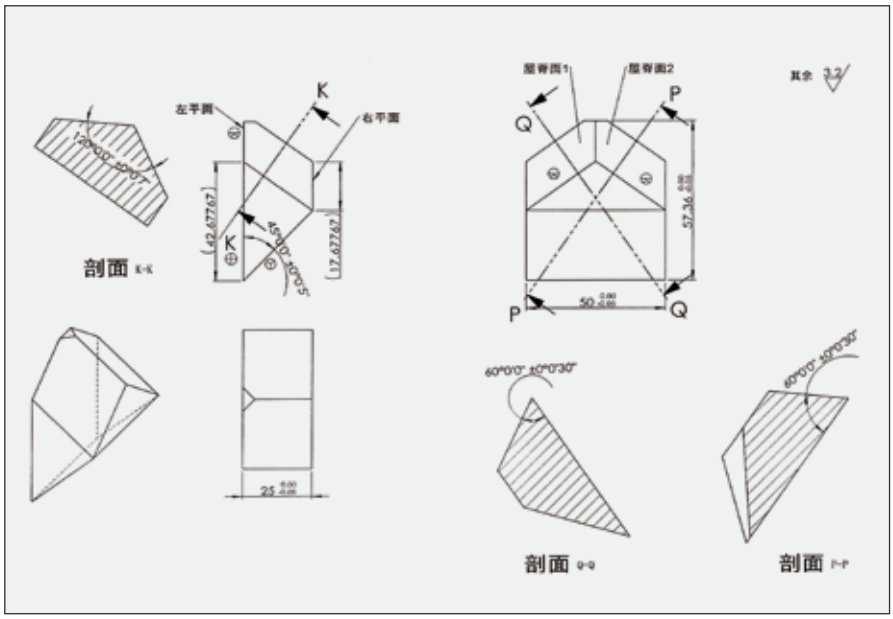
Extinction ratio: Tp/Ts>1000: 1; angle of incidence: 45±3°

2. Angle between the left plane and ridge plane 1: 60°±30″; angle between the left plane and ridge plane 2: 60°±30″

Angle between the right plane and ridge plane 1: 120°±30″; angle between the right plane and ridge plane 2: 120°±30″

Angle between ridge plane 1 and ridge plane 2: 120°±7″

Product dimensions



Material requirements

ΔN_d	1B
ΔV_d	1C
Optical uniformity	3
Optical absorptivity	2
Stress birefringence	2
Fringe intensity	1C
Extent of bubble	1C

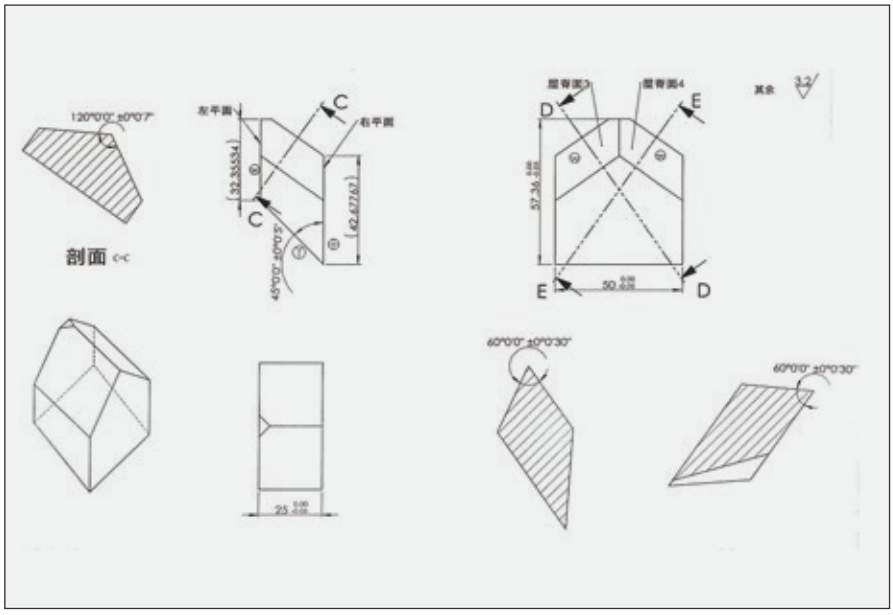
Element requirements

N	0.5
ΔN	0.2
S/D	40/20
D_0	25*46

Materials

Name	SF2
Nd	1.6477
Vd	32.848

Product dimensions



Material requirements

ΔN_d	1B
ΔV_d	1C
Optical uniformity	3
Optical absorptivity	2
Stress birefringence	2
Fringe intensity	1C
Extent of bubble	1C

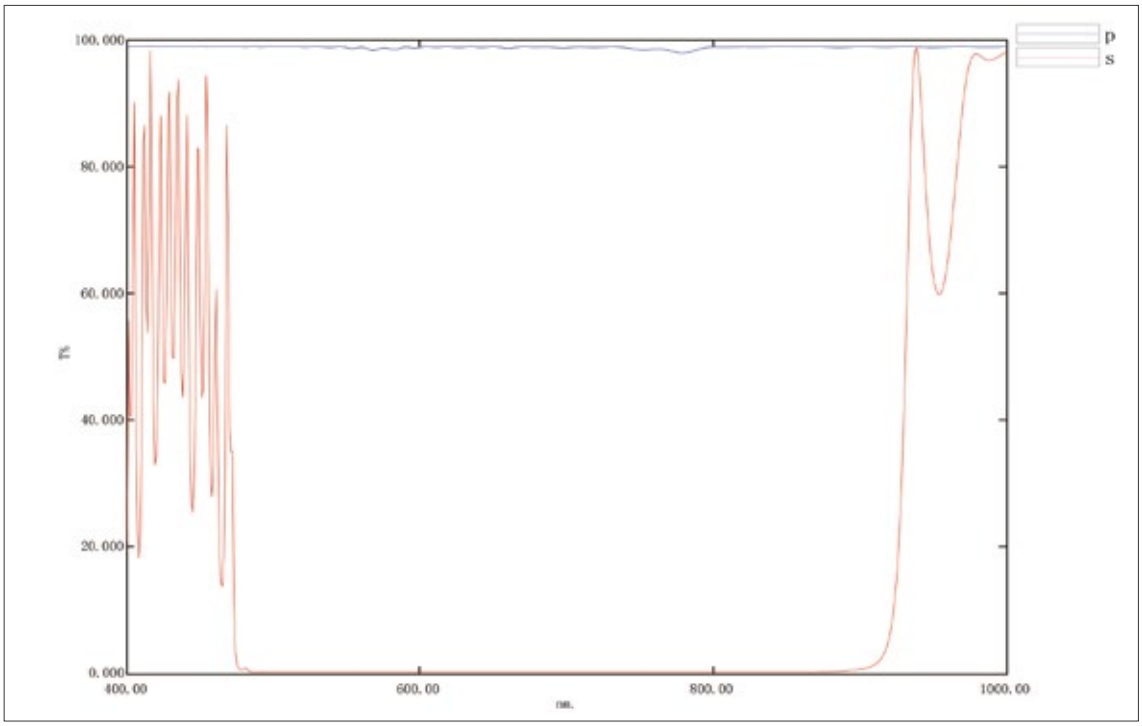
Element requirements

N	0.5
ΔN	0.2
S/D	40/20
D_0	25*46

Materials

Name	SF2
Nd	1.6477
Vd	32.848

Overlapping Spectrum Image Report



Application case 4:

Technical requirements:

1. Coating requirements: 1563.05nm

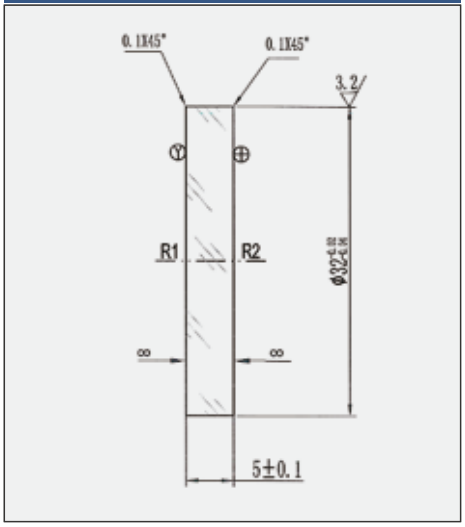
R >95%@1563.05nm ±0.1nm; 1540.56nm ± 0.1nm (beam splitting), 95%±1% (reflection)

5%±1% (transmission); beam splitting is realized through a single surface (R1), and surface R2 serves as the transmitting surface only.

2. surface accuracy requirement: Test with an interferometer (angle of incidence: 16°) and a test wavelength λ of 632.8nm. In the clear aperture range, beam splitting surface R1 (coated) has a surface accuracy RMS superior to λ/15 (including power) or λ/30 (excluding power) (power is superior to 0.5λ); the transmitted wave aberration (after coating) has an RMS superior to λ/30 (including power).

3. The parallelism is superior to 0.01mm.

Product dimensions



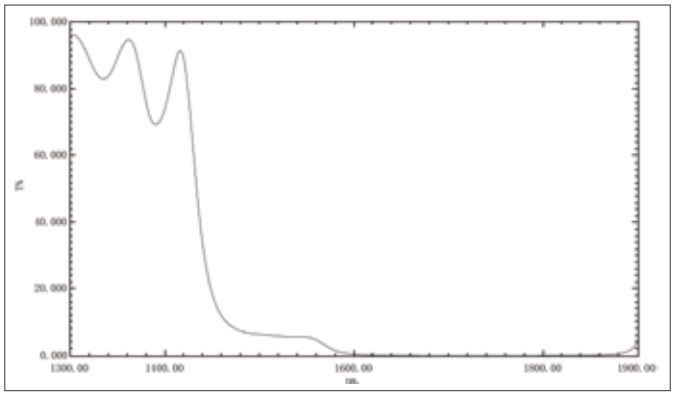
Quality of optical glass

ΔN_d	/
ΔV_d	/
Optical uniformity	H2
Optical absorptivity	1C
Stress birefringence	2
Fringe intensity	1C
Extent of bubble	3

Precision of optical machining

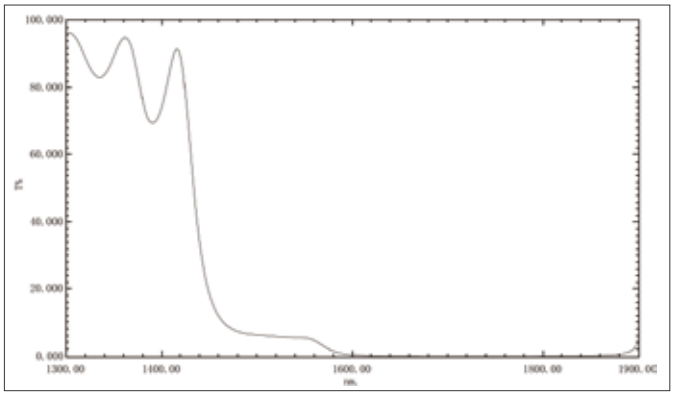
	R1	R1
Sample precision △R	A	A
Radius deviation N	/	/
Partial deviation △N	/	/
Eccentricity c	/	/
Surface finishment MIL	Ⅲ	Ⅲ
Clear aperture Do	Φ31	Φ31

Beam Splitter 2A Spectral Point Test Report



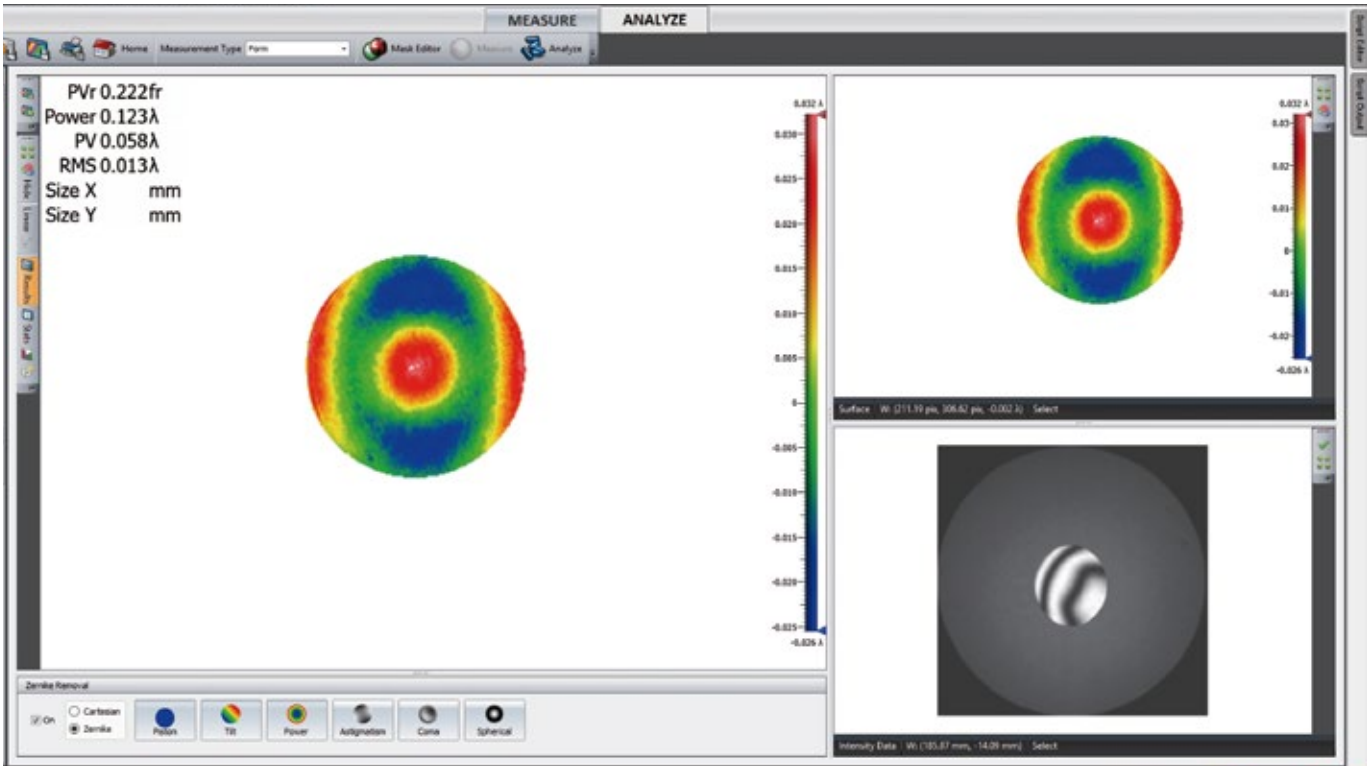
No.	Wavelength (nm)	Transmissivity
1	1540.00	5.545
2	1563.00	4.236

Beam Splitter 2A – S1 Spectral Point Test Report



No.	Wavelength (nm)	Transmissivity
1	1540.00	5.545
2	1563.00	4.236

Coated surface flatness precision



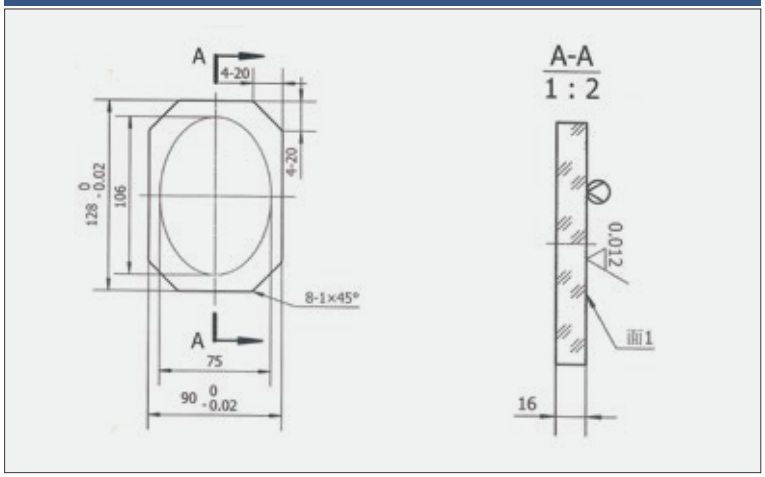
Reflecting coatings

Application case 1:

Technical requirements:

1. Surface accuracy requirements: After coating: RMS ≤ λ/40; Pvr ≤ λ/4 (λ = 632.8nm) (angle of incidence: 45°)
2. Chamfer: 0.6 x 45°
3. Reflection Coatings on surface 1; anti-damage threshold: >1.71J/cm2@8ns, 214MW/cm2; Rs≥99.8%, Rp≥99.8% (for the 1064nm wave band), or Rs≥95%, Rp≥95% (for the 532nm wave band)
(for the 532nm wave band) (angle of incidence: 45°)

Product dimensions



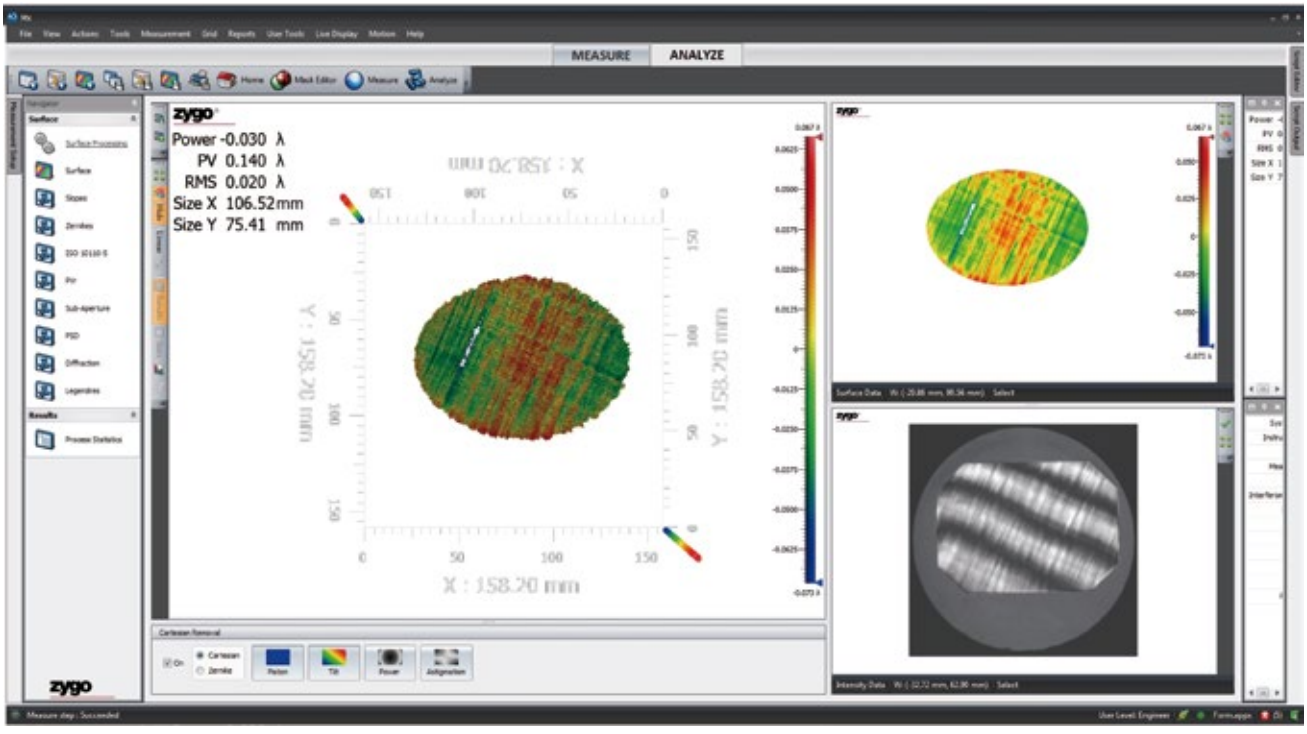
Material requirements

Optical uniformity	/
Birefringence	/
Fringe density	/
Extent of bubble	/

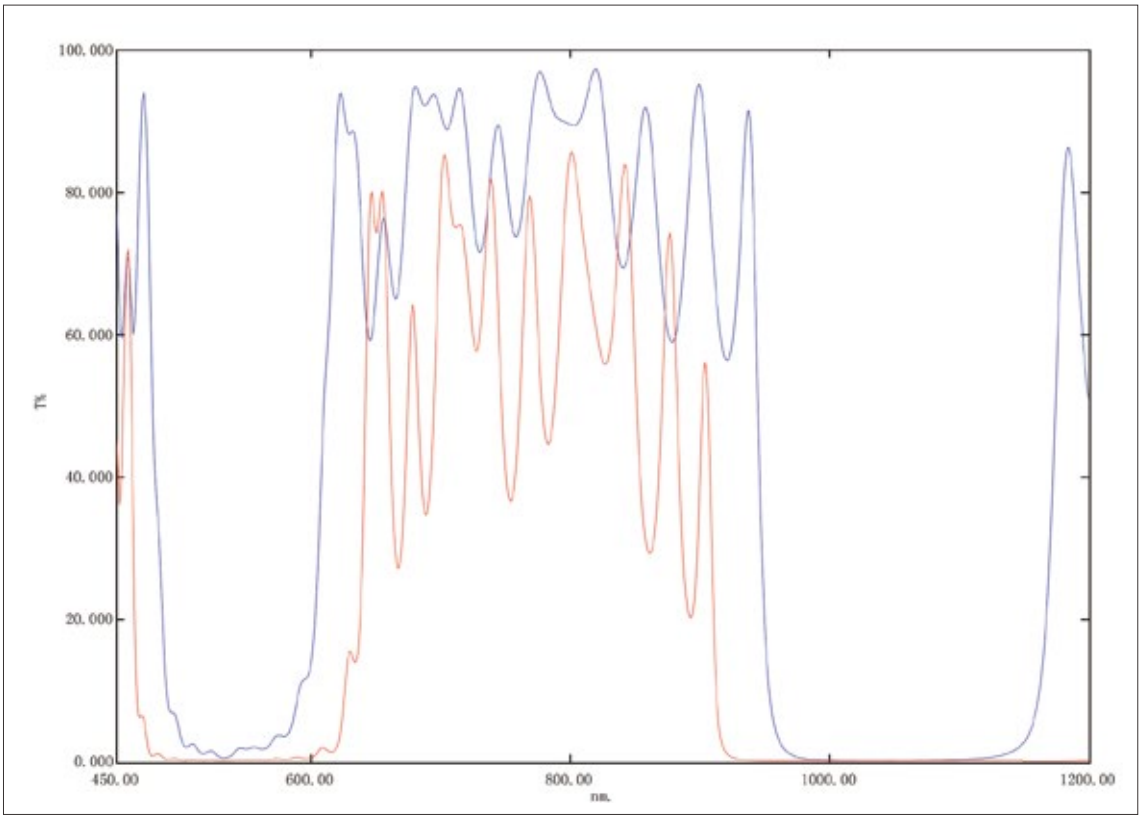
Product dimensions

P	Ⅲ
Φ1	106*75
Φ2	/

Coated surface flatness precision



verlapping Spectrum Image Report



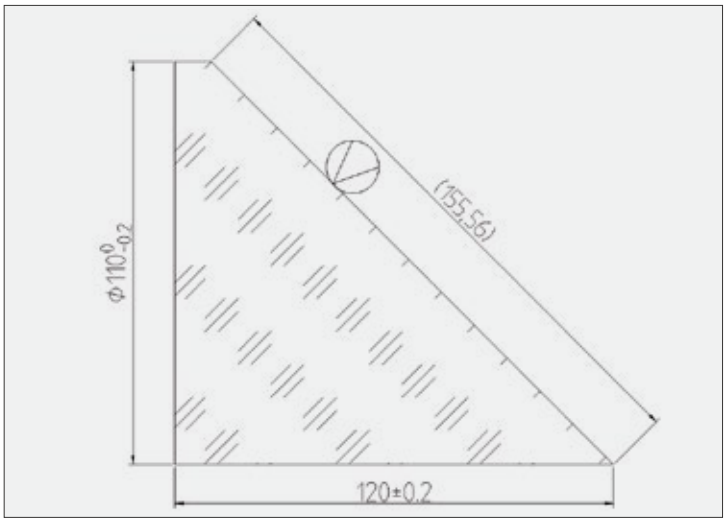
Application case 2:

Technical requirements:

1. Coating requirements: Fully reflecting dielectric coatings; angle of incidence: 45 °±1.5 °; reflectivity R (1080nm ± 30nm): >99.5%, or reflectivity R (486nm ~ 656nm): > 90%; optical element absorptivity: <0.01%

2. The coated reflecting surface has a surface accuracy superior to λ/6 (P -V) or λ/40 (RMS) (angle between the test beam and the mirror surface's normal: 45 °; test wavelength: 632.8nm; power density: 5000W/cm^2)

Product dimensions



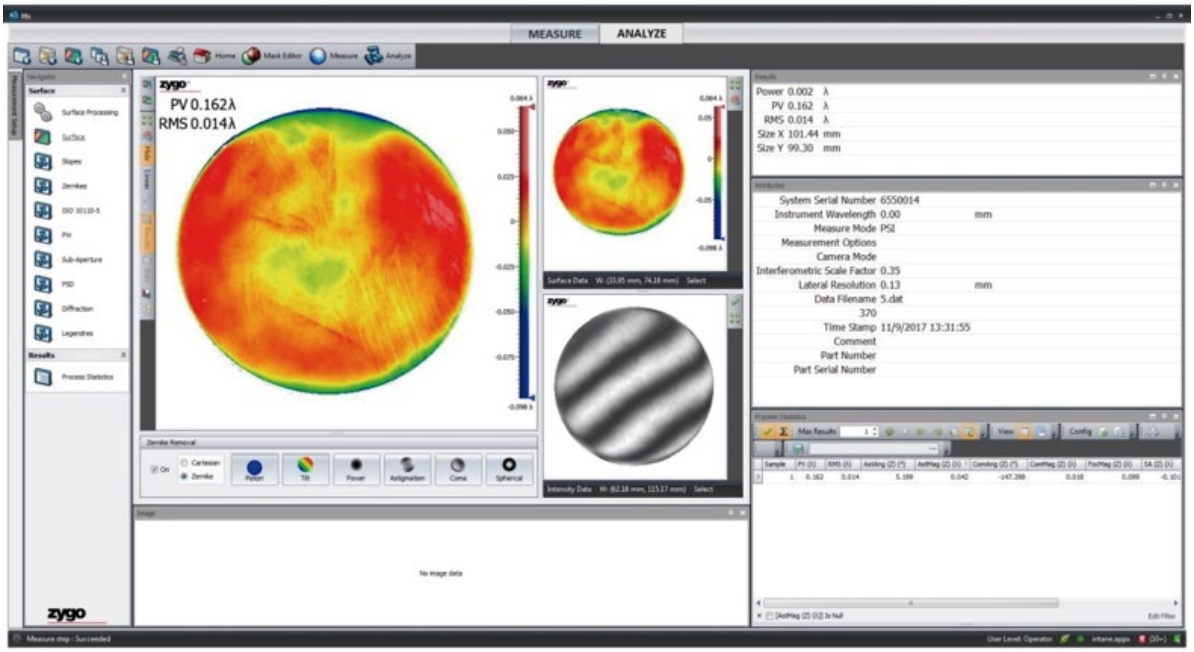
Material requirements

Optical uniformity	/
Birefringence	/
Fringe density	/
Extent of bubble	/

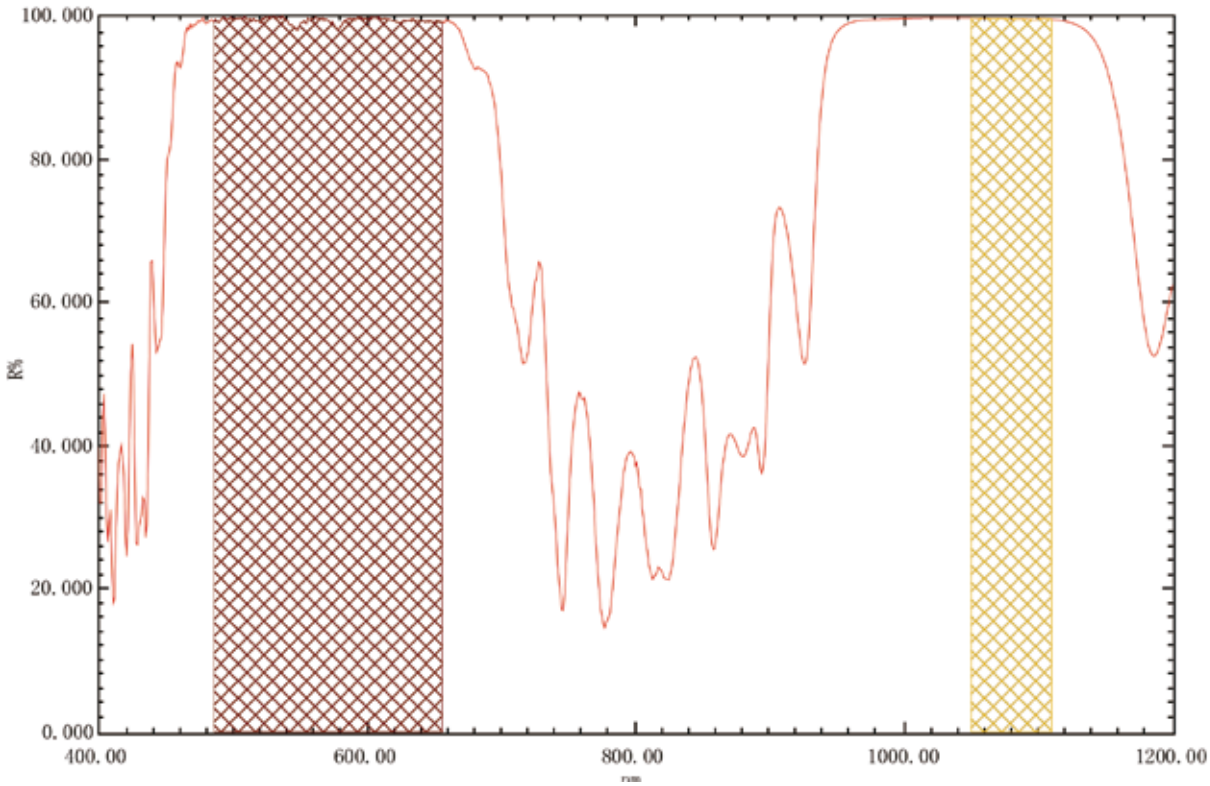
Product dimensions

P	Ⅲ
Φ1	106*75
Φ2	/

Coated surface flatness precision



Spectral Peak Area Report



Zone	Color	Begin	End	Divisor	Area	Result	Description
1		486.00	656.00	170.000	16893.831	99.375	
2		1050.00	1110.00	60.000	5975.694	99.595	
3							

Application case 3:

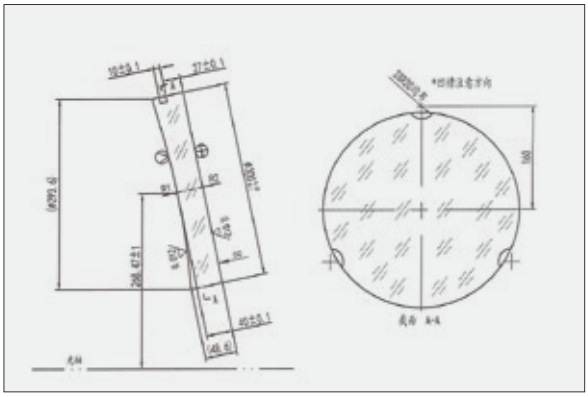
1. Surface R1 is an aspheric surface. The equation is: y2 = 2Rx – (1+k)x2. The radius of curvature of its top is: R = - 1281.12±1mm, K = -10.001, ady = 268.47 ±1mm

2. surface accuracy requirements: Testing is done with an interferometer. The uncoated surface accuracy is superior to λ/50RMS; PVQ is superior to λ/7; the coated surface accuracy is superior to λ/30RMS (λ = 632.8nm).

3. Coating requirements: Protective coatings over the reflecting dielectric coatings coated on surface R1; angle of incidence: 12°±8°; reflectivity >99.5% (operating wave band: 1050nm~1100mm), or reflectivity >98.5% (operating wave band: 500nm ~ 850mm); no damage after continuous impact with a maximum power density of 1000W/cm (@1050nm~1100nm)

4. Surface R2: Polished; anti-reflection coatings; operating wave band: 1050nm~1100nm.

Product dimensions



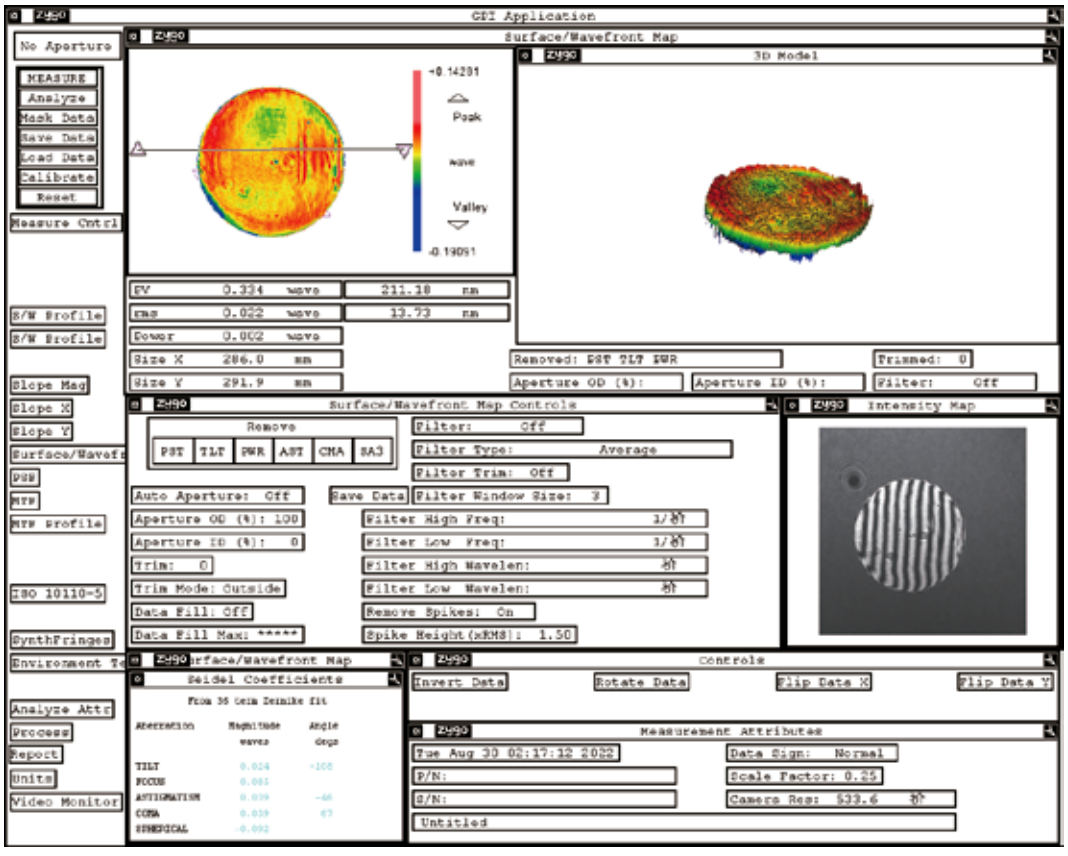
Product dimensions

N_d	/
V_d	/
Optical uniformity	/
Optical absorptivity	/
Stress birefringence	2
Fringe intensity	/
Extent of bubble	1C

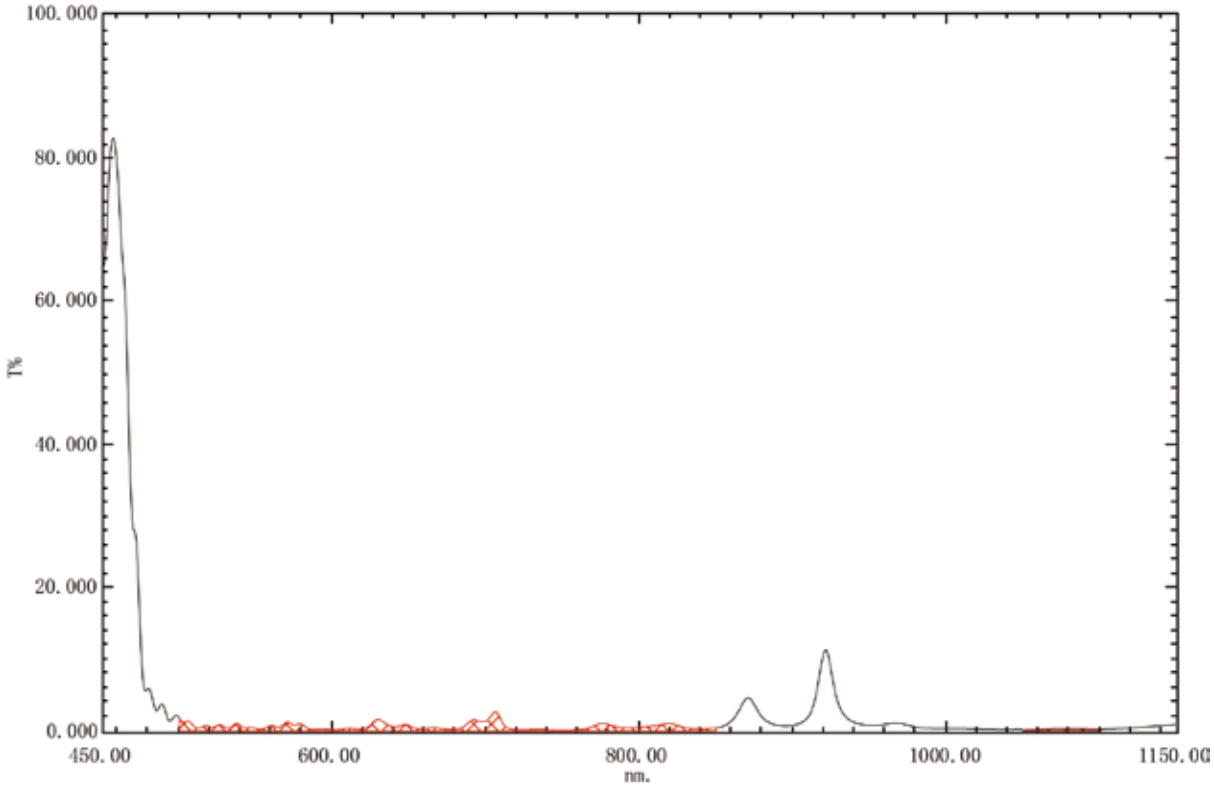
Product dimensions

	R1	R1
Specimen precision △R	/	/
Radius deviation N	/	/
Partial deviation △N	/	/
Eccentricity c	/	/
Surface finishment MIL	Ⅲ	Ⅲ
Clear aperture Do	Φ292	Φ292

Coated surface flatness precision



Spectral Peak Area Report



Zone	Color	Begin	End	Divisor	Area	Result	Description
1		500.00	850.00	350.000	218.036	0.623	
2		1050.00	1100.00	50.000	12.880	0.258	
3							

Filter coatings

Application case 1:

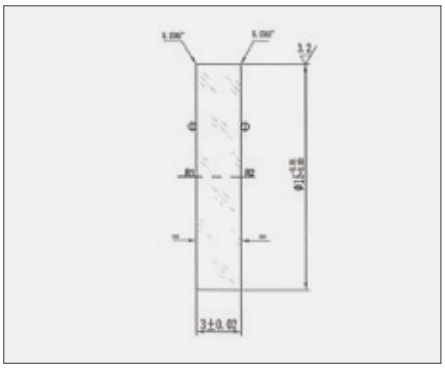
Technical requirements:

1. Coating requirements: 1560.05nm filter coatings; operating angle: 0°~2°
2. Pass band: center wavelength: 1563.05nm±2nm; FWHM ≤20NM; T >92% @ 1563.05nm ±1nm
3. Stop band: Within the stop band (400nm ~ 1800nm wave band, excluding the pass band): Tavg <0.2%; T <0.01%@1540.56nm ± 1nm (0D4)
4. surface accuracy requirements: Testing is done with an interferometer; λ = 632.8nm.

Uncoated condition: Transmitted wave aberration (including power): superior to 1/60 λRMS; two surface accuracy (including power): superior to 3λPV

Coated condition: Transmitted wave aberration (including power): superior to 1/40 λRMS (testing can be done with a wavefront sensor. In the case of a subaperture of Φ8.8mm: RMS: superior to λ/97; λ=1563nm; 4 apertures at least); parallelism: superior to 0.01mm.

Product dimensions



Product dimensions

N_d	/
V_d	/
Optical uniformity	H2
Optical absorptivity	1C
Stress birefringence	2
Fringe intensity	1C
Extent of bubble	3

Product dimensions

	R1	R1
Specimen precision △R	A	A
Radius deviation N	/	/
Partial deviation △N	/	/
Eccentricity c	/	/
Surface finishment MIL	Ⅲ	Ⅲ
Clear aperture Do	Φ14.1	Φ14.1

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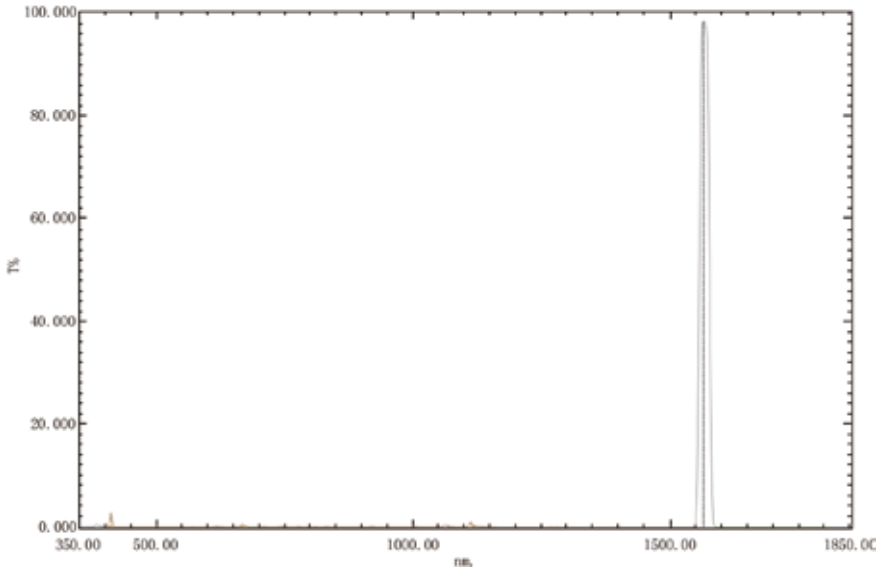


Zone	Color	Begin	End	Divisor	Area	Result	Description
1		400.00	1545.00	1145.000	75.689	0.066	
2		1585.00	1800.00	215.000	0.711	0.003	
3		1540.00	1541.00	1.000	0.008	0.008	
4		1563.00	1564.00	1.000	98.135	98.135	
5							

Application case 1:

Technical requirements:

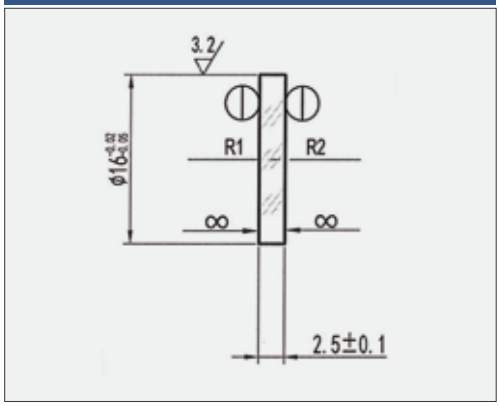
1. surface accuracy requirements: Coated transmitted wave aberration (including power): superior to λ/40RMS (λ = 632.8nm)
2. Coating requirements: Filter coatings coating on surfaces R1 and R2; operating angle: ±3°; overall filter indexes:

Pass band: center wavelength: 830nm; bandwidth: <5nm; T: >90%830nm

Stop band: 0D3 (in the 350nm ~ 1000nm wave band, excluding the pass band)

3. Parallelism: 0.01mm
4. The trim has protective chamfers.

Product dimensions



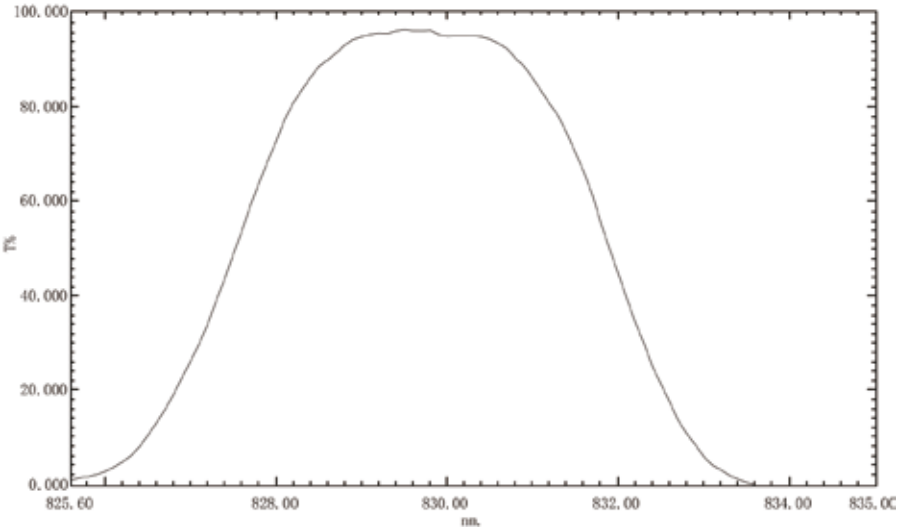
Product dimensions

N_d	/
V_d	/
光学均匀性	H2
光吸收系数	1C
应力双折射	2
条纹度	1C
气泡度	3

Product dimensions

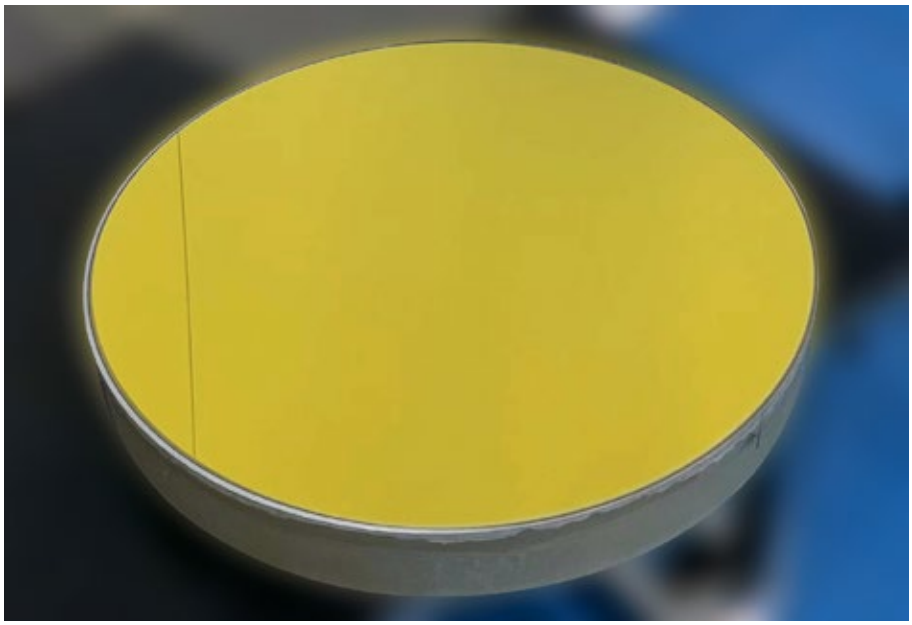
	R1	R1
样板精度ΔR	A	A
半径偏差N	/	/
局部偏差ΔN	/	/
偏心c	/	/
表面光洁度MIL	Ⅲ	Ⅲ
通光孔径Do	Φ15	Φ15

Spectral Peak Area Report

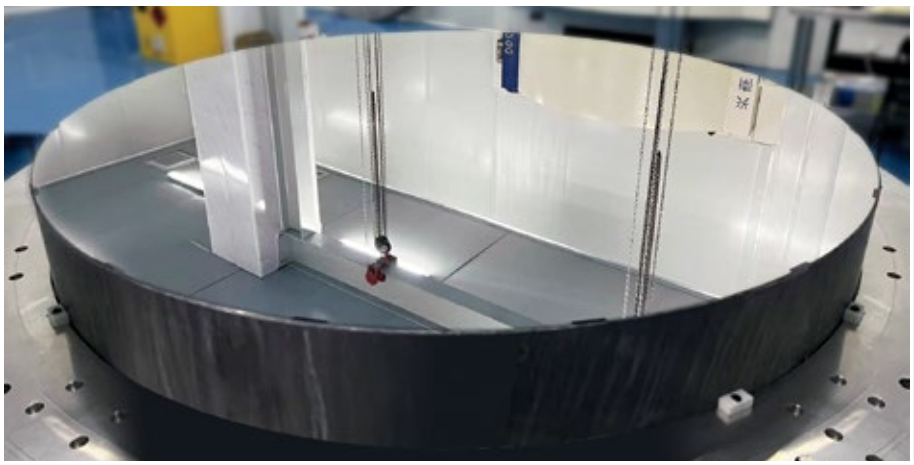


No.	Wavelength (nm)	Transmissivity
1	830.00	94.805
2	827.50	48.787
3	832.00	44.560

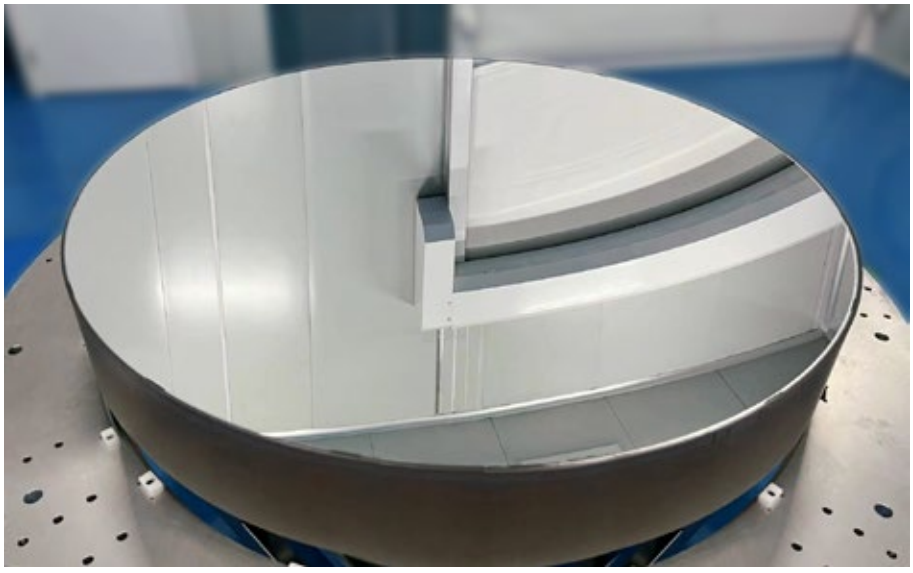
Metal film



◀ Gold coated



◀ Silver coated



◀ Aluminum coated

Application case of high surface accuracy high-reflecting coatings of large-aperture high-power laser damage threshold

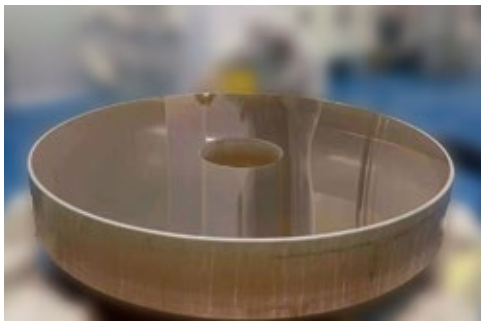
Technical requirements:

1. Aperture: D1230
2. Coating: Reflecting dielectric coatings; wave band: 420nm ~ 800nm; average reflectivity: ≥97%
3. Eccentricity between the primary mirror's optical axis and the excircle: ≤0.5mm
4. Uncoated mirror surface: PVr ≤λ/4; RMS ≤λ/40 (λ = 632.8nm)
5. Coated mirror surface: PVr ≤λ/3; RMS ≤λ/30 (λ = 632.8nm)
6. Error of radius of curvature at top: ≤1mm
7. Perpendicularity between the optical axis and back face A: 0.05mm

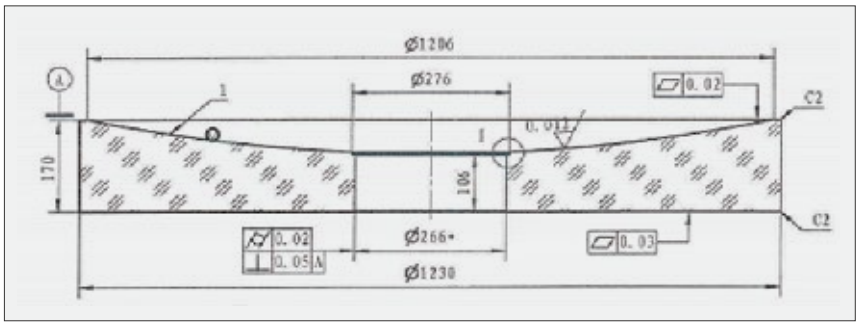
Precision of Optical Machining

Optical machining precision	≤0.5mm
Size	Φ266
Error of radius of curvature at top	≤1mm
Perpendicularity between the optical axis and end face A	0.05mm
Roughness of reflecting surface	≤2nm
Uncoated mirror surface flatness	PVr≤λ/4, RMS≤1/40 (λ=632.8nm)

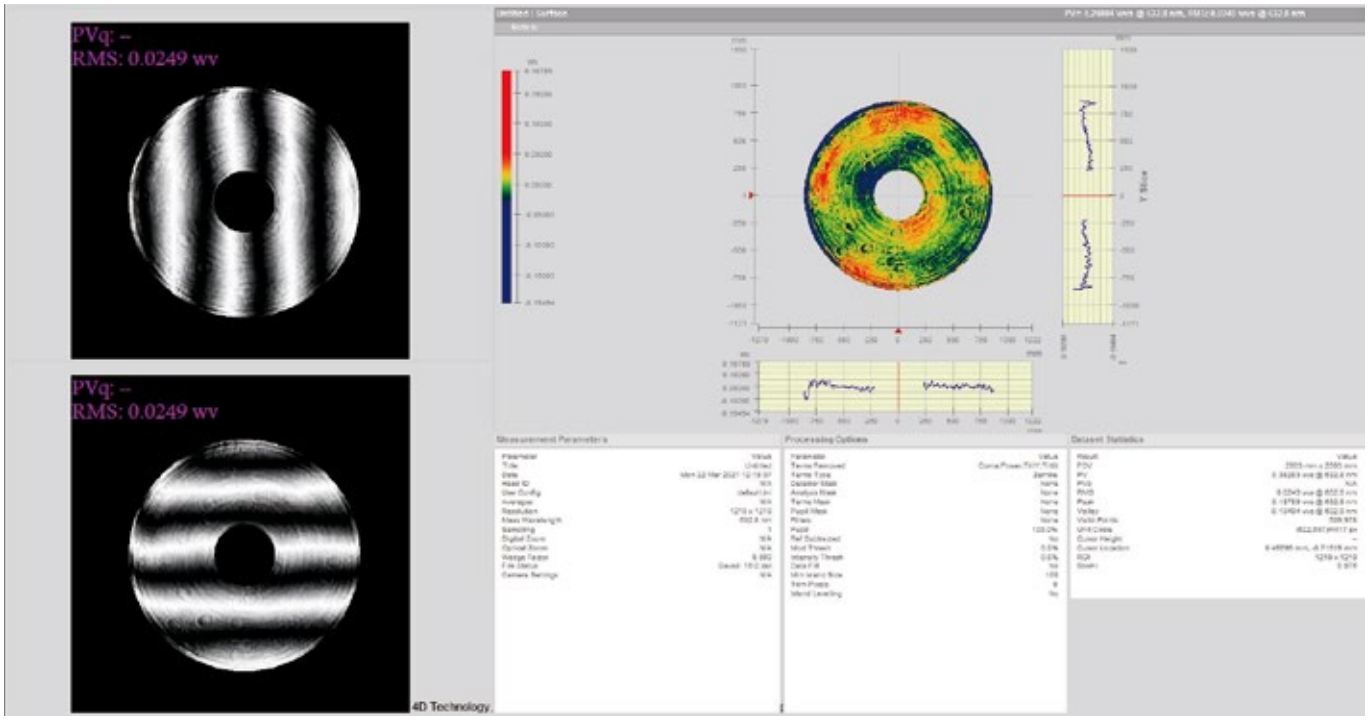
Physical uncoated mirror

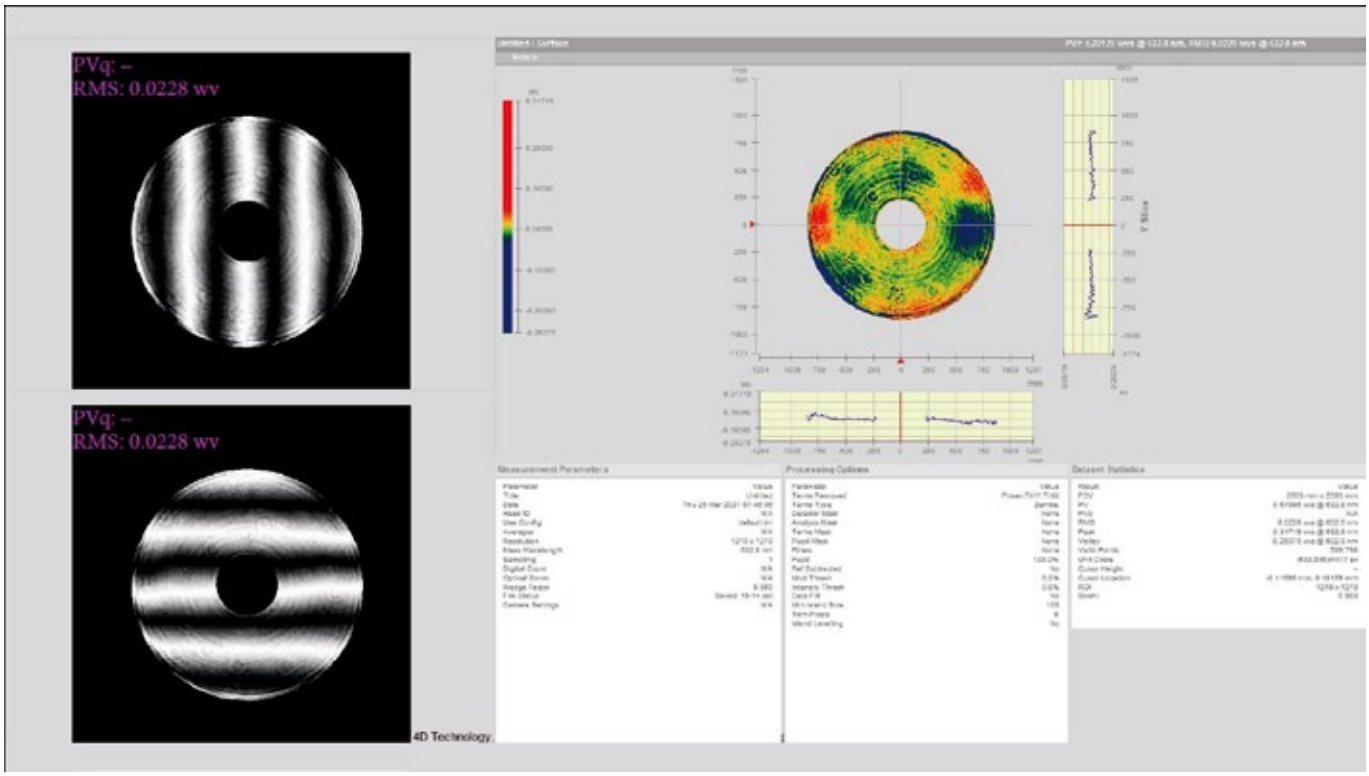


Product dimensions



Result of uncoated surface flatness test



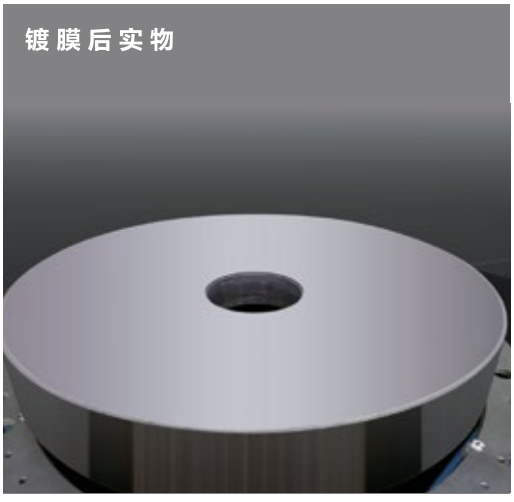


Result of the surface flatness test in the 0° direction in a Φ1200mm aperture range before coating of the large-field primary mirror.

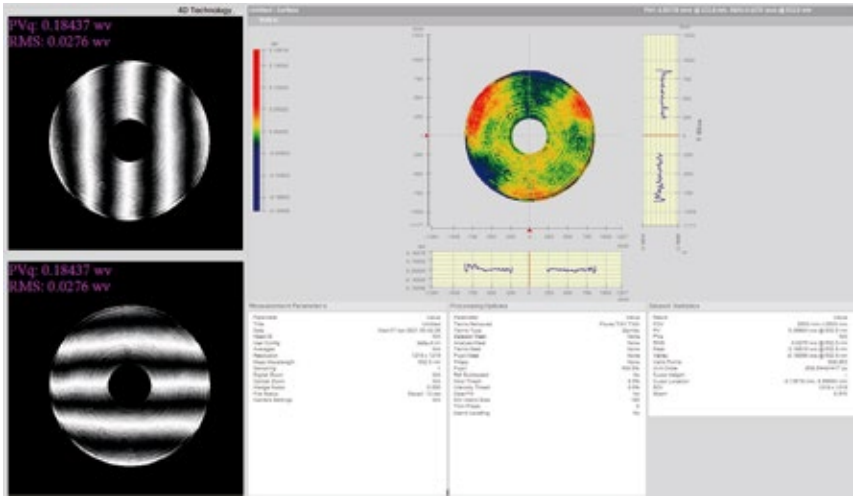
Technical difficulties:

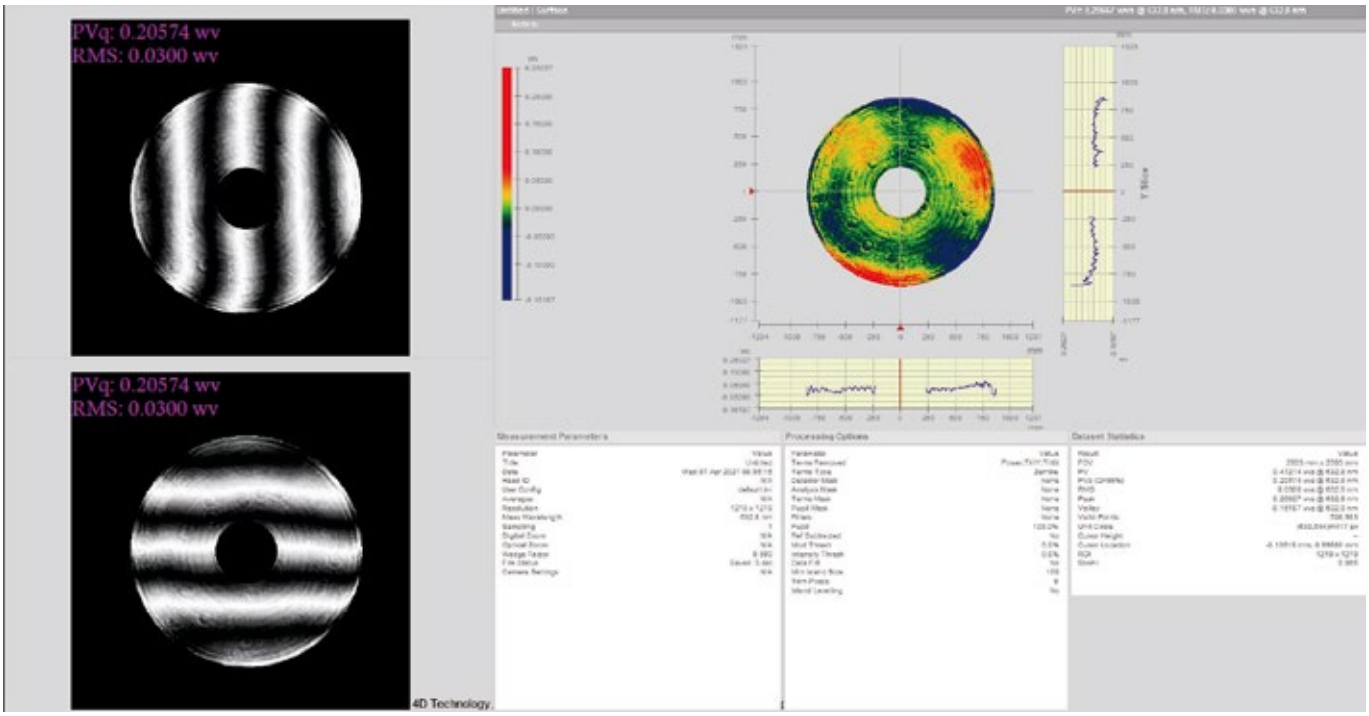
1. Coating requirements: Reflecting dielectric coatings; wave band: 420nm ~ 800nm; average reflectivity: ≥97% (angle of incidence: <15°) (The thick coatings results in some difficulties.)
2. Due to the large product size, the coatings uniformity is difficult to control.
3. Coated surface accuracy: PVr ≤λ/3; RMS ≤λ/30 (λ = 632.8nm)

Physical mirrors before and after coating



Result of surface flatness test after coating





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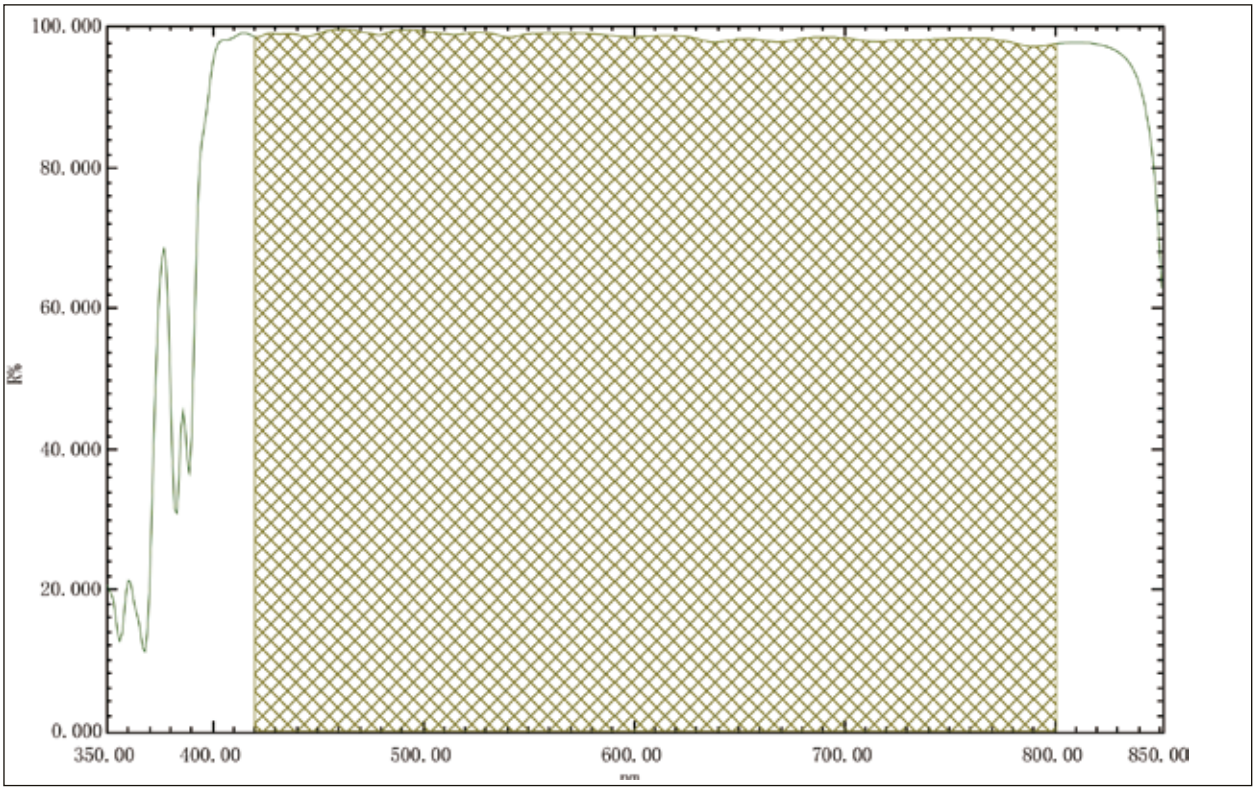
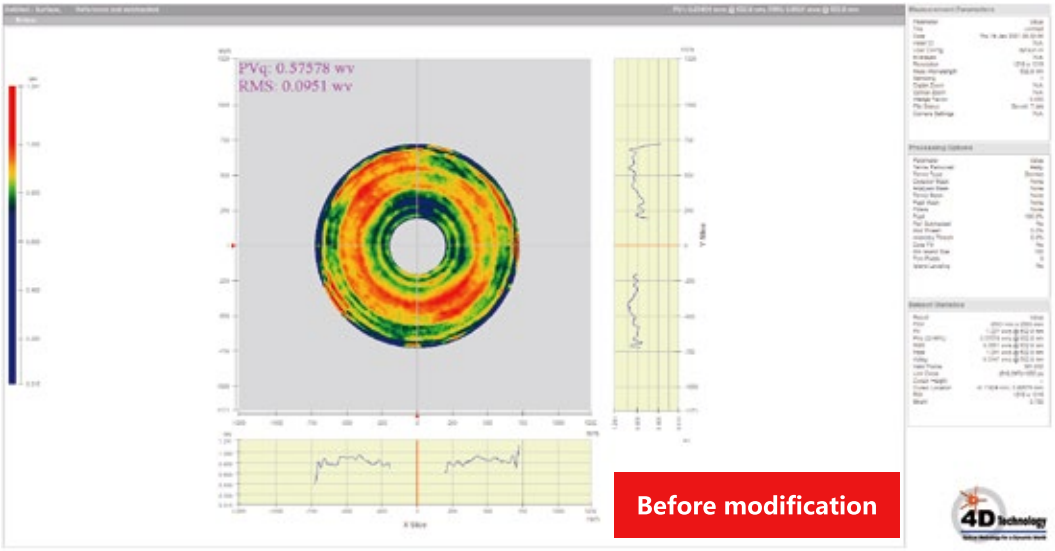


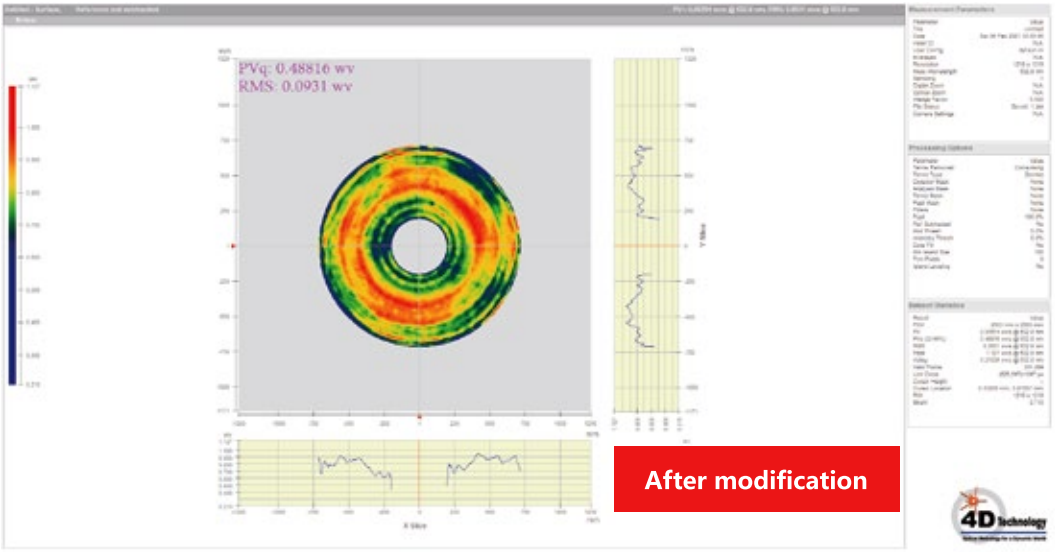
Zone	Color	Begin	End	Divisor	Area	Result	Description
1		420.00	800.00	380.000	37443.539	98.536	
2							

Large-aperture SiC modification

Result of surface flatness test of unmodified SiC primary mirror

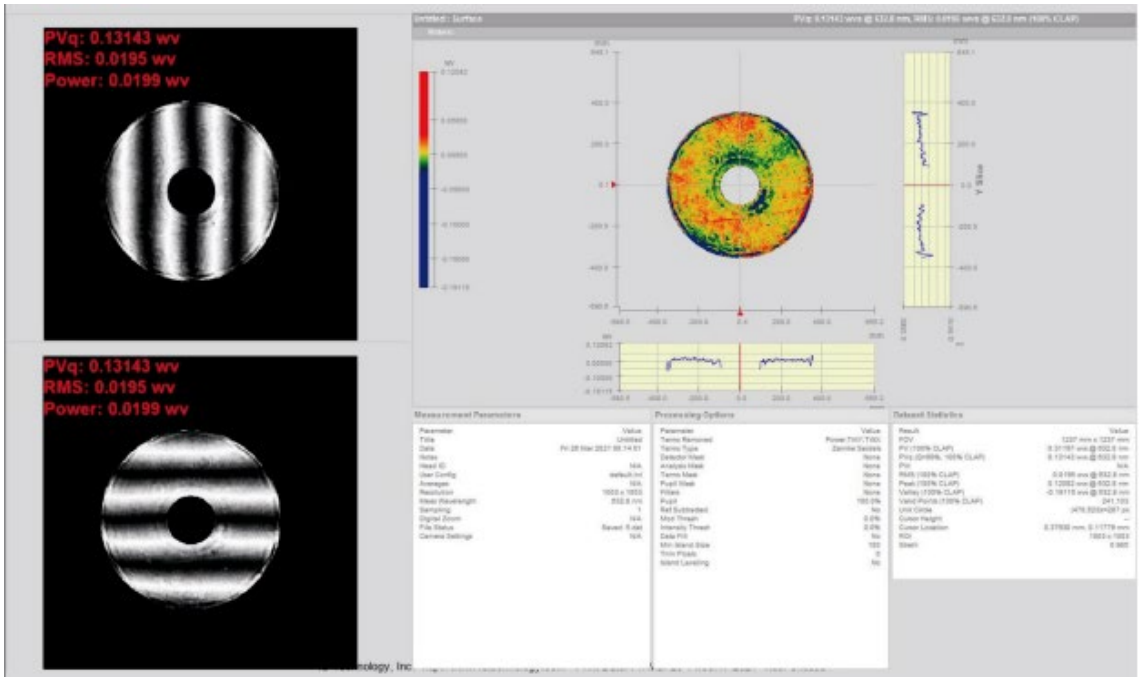


Result of surface flatness test of modified SiC primary mirror



Physical modified SiC primary mirror after finishing polish

Result of surface flatness test of modified SiC primary mirror after finishing polish

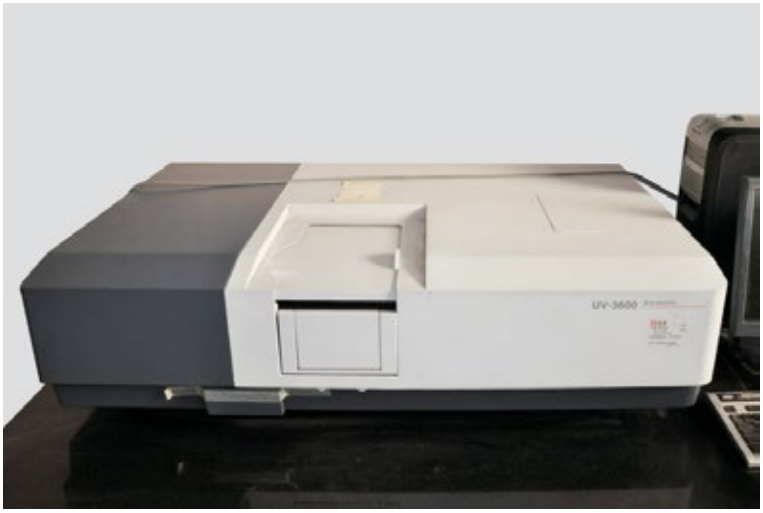


After modification

In possession of advanced R&D and production capacity in the optical coating field, and the largest D2200mm coating equipment, Intane can realize D1800 coating for optical elements and can machine high-precision optical elements with such special requirements for their surfaces as antireflection coatings, beam splitting coatings and filter coatings. The R&D team of Intane provides customers with better optical coating solutions by means of continuous innovation.

◀ Cary 7000 Spectral detector

The Cary7000 all-purpose spectrophotometer can measure samples of almost all types in the terms of their angles, reflectivity and transmissivity. The measurement modes include transmission, absolute reflection, absorption, and scattering.

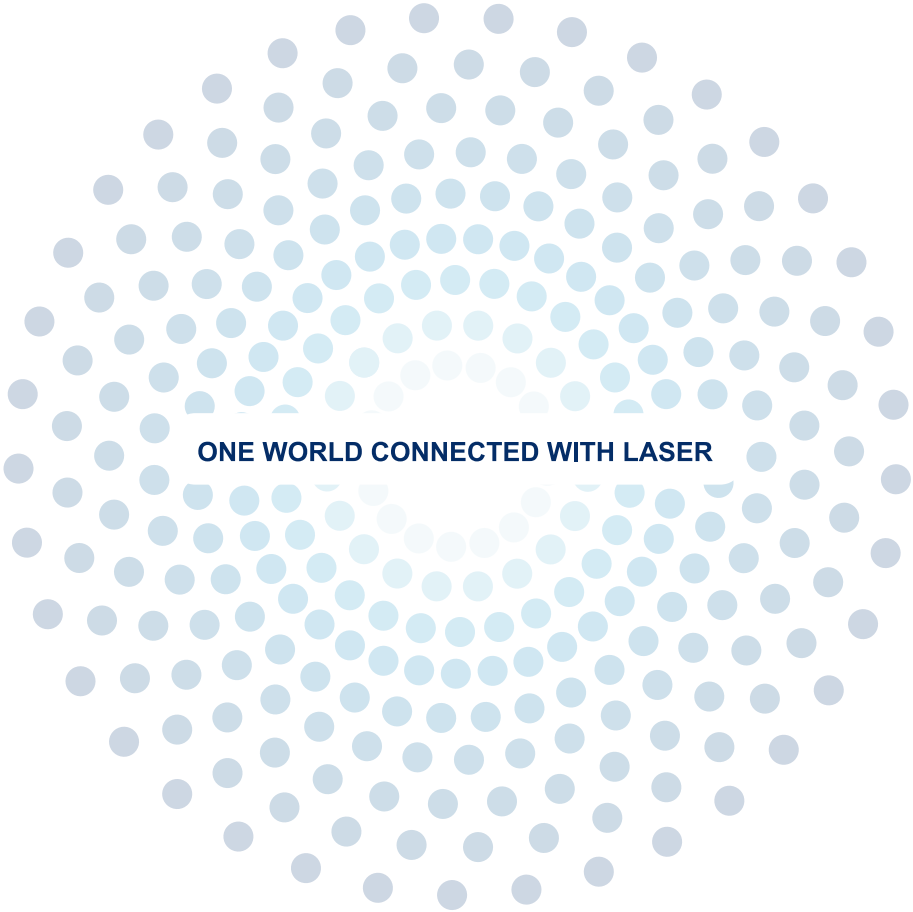


◀ UV3600 spectrophotometer

The UV3600 spectrophotometer is a new supplementary model among high-end UV-VIS-NIR spectrophotometers. It has high sensitivity, high resolution and abundant accessories suitable for different applications.

▼ UV3600 spectrophotometer

▼ Salt spray test equipment



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