SEOUL PRECISION OPTICS

Since 1996

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Transparent ITO

Multiple Cavity Metal-dielectric Filters

Fluorescence Filter

Gas Analysis Filter

Motion / Intrusion Filter

Beam Splitter

IR Anti-Reflection

HISTORY

- 1996. 04 — Established & Start on Optical Coating (For Visible Area)
- 1999. 03 — Developed BPF on Visible Area (For welding)
- 2000. 06 — Developed IR Filters (LWP, SWP)
- 2001. 01 — Achieved the ISO 9002:1994 Certificate
- 2003. 03 — Developed Gas filter(NBPF. WBPF)
- 2003. 08 — Achieved the ISO 9001:2000 certificate
- 2004. 05 — Launched SPO's own Sputtering Coating System. (Fluorescence Filter.)
- 2009. 10 — Set-up 2ND factory. (Plant for IR Filter)
- 2010. 06 — Launch Joint laboratory with In-ha University. (Plant for Fluorescence Filter.)

SEOUL PRECISION OPTICS

Since 1996

Seoul Precision Optics Co. has been supplying high quality optical coating based on partnership relation with customer for many years.

Vacuum deposition technology has progressed significantly over the years and SPO has remain strong position in this dynamic field. Our current coating designs are applied using some of the newest and most progressive deposition procedures. Seoul Precision Optics offers its customers an uncommon collection of technical depth, personalized service, and competitive pricing. We are committed to manufacturing quality thin films through improved production method and superior workmanship. Contact on of our sales engineers to discuss your specific requirements. We look forward to applying our thin film technology and progressive production methods to your application.

Very truly yours,

President

Chim Mun Sig

Chim Mun Sig

TECHNICAL INFORMATION

SEOUL PRECISION OPTICS CO.

CONTENTS

▶ Center Wavelength (CWL)

$\lambda 0 = (\lambda 1 + \lambda 2) / 2$

Where $\lambda 1$ and $\lambda 2$ are the wavelength at 50% of Peak Transmittance.

▶ Band Width (FWHM)

$\lambda 2 - \lambda 1$

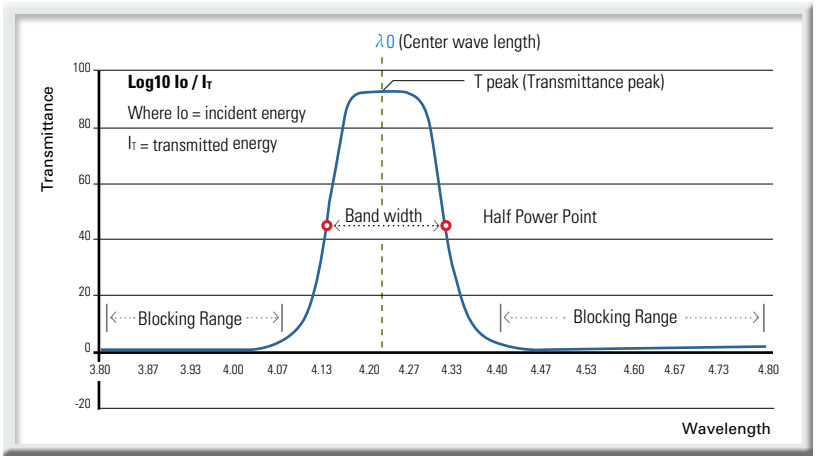
Where $\lambda 1$ and $\lambda 2$ are the wavelength at 50% of Peak Transmittance.

▶ Peak Transmittance (Tpeak)

T peak = Maximum transmittance with in the band pass region.

▶ Out of Band Blocking

It is the amount of energy to the total energy out side the band pass.
Commonly refer to as signal to noise ratio (S/N), or it is usually express in Optical Density (O.D).



▶ Band Pass Shape

Band pass shape is defined to the number of cavities in a filter. The more cavity, the more extremely rectangular shape, very steep edges. The number of cavities is defined by customer's requirement about center wavelength, full width at half maximum, transmittance, and blocking.

▶ Slope

%SLOPE = {λ (80%)-λ (5%) / λ (5%)} x 100%

▶ Wavelength shift with angle

Thin film interference filters change with incident angle.

he following equation may be used to define the wavelength at a certain angle of incident.

$\lambda = \lambda_O \sqrt{1-(n_O / n_{eff})^2 \sin^2 \theta}$

λ = wavelength at angle of incident

λ_O = wavelength at normal incident

θ = angle of incident

n_O = reflective index of external medium

n_{eff} = effective reflective index of filter

▶ Wavelength shift with temperature

The center wavelength will shift to a longer wavelength with increasing temperature.

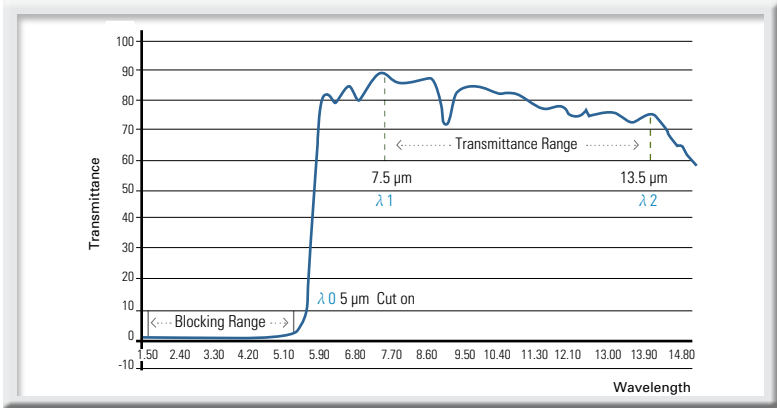
This shift is expressed to following equation.

$\lambda(℃) = \lambda_O + \nabla T (\nabla \lambda_O / 1℃)$

$\nabla \lambda_O / \nabla ℃$ = 0.01 nm / ℃(nominal)

▶ Cut on (λC)

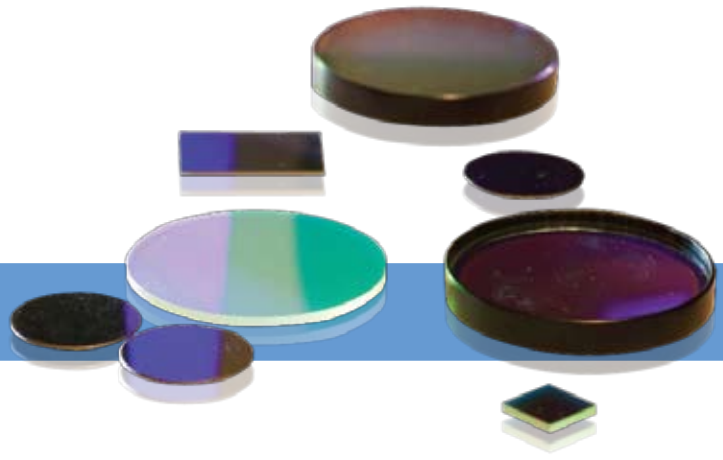
This is the wavelength at which the edge filter begins to transmit. Commonly it is specified at the wavelength of 50% absolute transmittance in UV to Near Infrared region. Specially it is specifies at the wavelength of 5% absolute transmittance in Far Infrared region. Cut on wavelength is applied by Long Wave Pass Filter.



▶ Percent Transmittance (Tave %)

λ 1, λ 2 Transmittance region of Edge Filter.

Transmittance in region is defined as average transmittance(Tave(%)).



Transparent ITO

ITO Coating

▶ Application

Touch pannel, TFT-LCD, industrial management system

▶ Property

Using Magnetron sputtering, ITO coating has excellent durability from the environmental impact.

▶ General Specification

·Substrate

Float Glass(soda-lime)

·Dimension(mm) 100mm x 200mm

·Transmission

Index Mached ITO : over 90% at 450mm~700mm

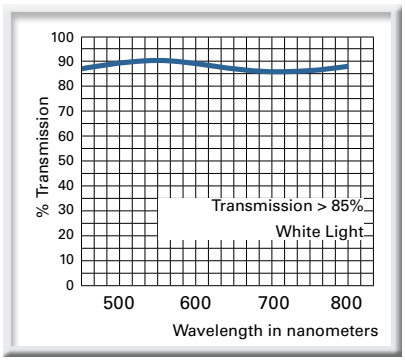
ITO : over 85% at 550nm

·Electrical Resistivity

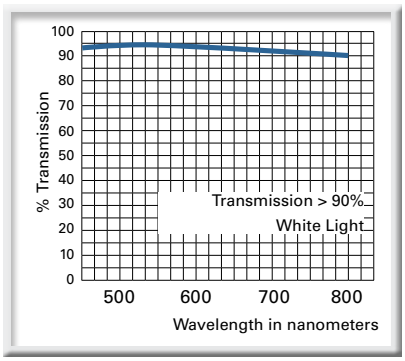
Most ITO coated glass is available in surface resistivities from 5 ohms/square to 1000 ohms/squre.

ITO coated products are manufactured to meet specifications of surface resistance and transmittance. Adhesion and corrosion resistance for these coatings are excellent.
Many film designs are available for glass and plastic substrates to meet various ohms per square and transmission requirements.

▶ Without Anti-Reflection coated ITO



▶ With Anti-Reflection coated ITO



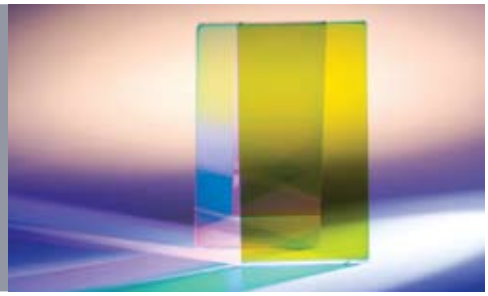
▶ Ordering Information

Coating Type	Rs(%)	Trasmission(%)	Passivation	Filter Number
One Side ITO	10±15	> 87	CALL	S-ITO-10
One Side ITO	50±15	> 85	CALL	S-ITO-50
One Side ITO	100±15	> 85	CALL	S-ITO-100
One Side ITO	200±15	> 85	CALL	S-ITO-200
Both Side ITO	10±15	> 80	CALL	B-ITO-10
Both Side ITO	50±15	> 80	CALL	B-ITO-50
Both Side ITO	100±15	> 80	CALL	B-ITO-100
Both Side ITO	200±15	> 80	CALL	B-ITO-200
One Side ITO with AR	10±15	> 90	CALL	SA-ITO-10-
One Side ITO with AR	50±15	> 90	CALL	SA-ITO-50-
One Side ITO with AR	100±15	> 90	CALL	SA-ITO-100-
One Side ITO with AR	200±15	> 90	CALL	SA-ITO-200-

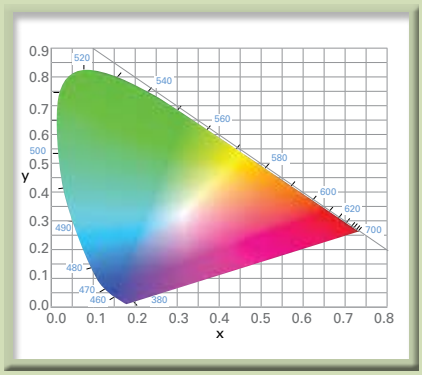
Other Radio and sizes are available upon request

Multiple cavity Metal-dielectric Filter

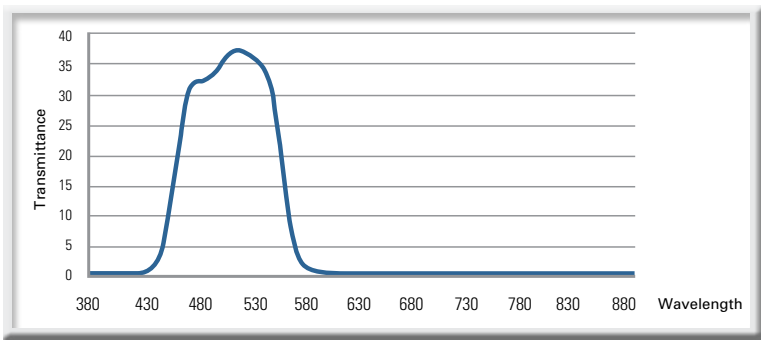
UV. IR cut filter
Welding Band pass filter



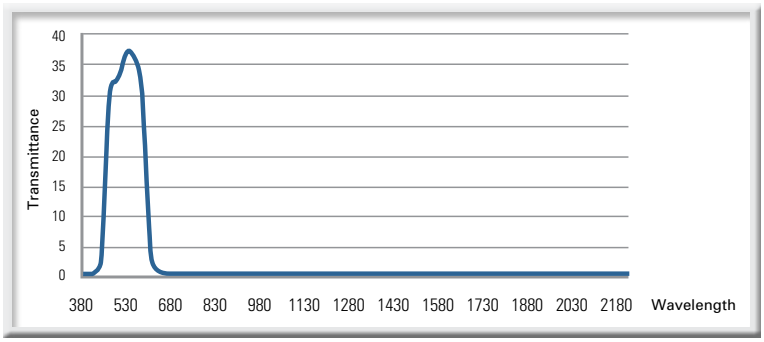
Auto Darken welding cartridge is used for "high efficiency" and to protect eyes from the noxious light during the welding process. Welding band pass filter is a key component of Auto Darken welding cartridge. It blocks UV & IR and is designed to adjust transmittance of Visible light. Welding filter can customize the transmittance at all of wavelength depending on the working environment and the type of welding. The filter can come in different sizes based on customer's inquiry.



▶ Multiple cavity metal dielectric filters



▶ Multiple cavity metal dielectric filters



▶ Application

Auto Darkening welding Helmet

▶ Property

Block the UV and IR lights for protecting human's eye during their welding process.
Reflection color & visual transmittance can be designed based on customer's request.

▶ Quality passed all ANSI and EN specification

*** American National Standards Institute (ANSI) Z87.1-1989(2 FEB.89)**

Standard Practice for Occupational and Education Eye and Face Protection.

*** European Standard EN 169:1992**

Filter for Personal Eye-protection Equipment used in Welding and Similar Operations.

Interference Band Pass Filter

Visible band pass filter
Fluorescence Filter

▶ Application

Fluorescence microscopy, Flow cytometry, DNA microarray scanners, Real-timme PCR, Imaging systems.

▶ Property

High peak transmission, Deep blocking over wide spectral ranges, precise edge placement, Hard dielectric coating/epoxy free optical path

▶ General Specification

· Transmission for filter.

Passband transmission Typically over 90%

Blocking Transmission Typically 0.01%, OD4

· Surface Quality

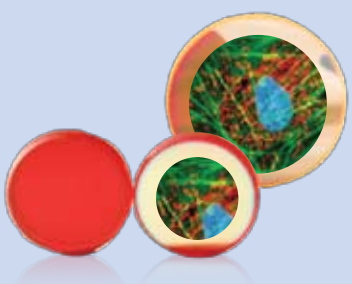
60-40 scratch-dig as per MIL-STD-48497A

· Physical Durability

MIL-C-48497A

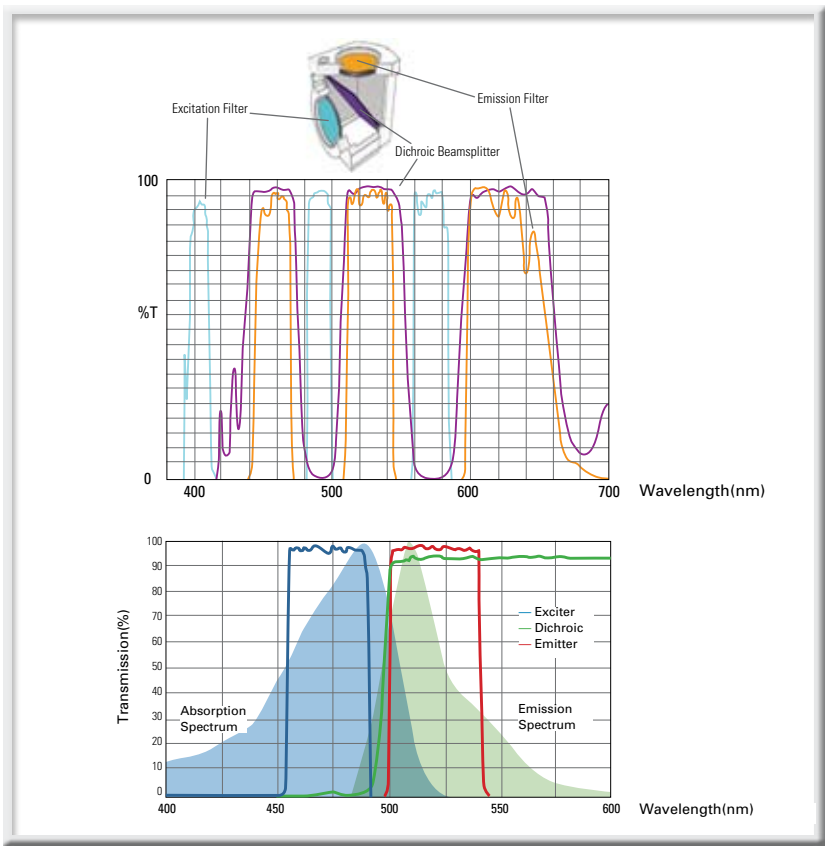
· Coating type

"Hard" Magnetron Sputtered–epoxy free.



For best results, select excitation and emission filters with center wavelengths as close to the absorptive and emissive peaks as possible. This gives the best possible yield from the selected dye.

Fluorescence filter set is composed of an excitation filter, an emission filter, and a dichroic beamsplitter. A filter set may be designed to work with a single fluorophore or with multiple fluorophores simultaneously. The Superior precision and repeatability of the Magnetron sputtering or Evapolator deposition platform enables the realization of filters with exceptional blocking levels, high transmission levels, and very steep transition zones. The practical result in fluorescence based applications is bright, high-contrast images.



▶ Ordering Information

fluorochromes and stains	Excitation Max (nm)	Emission Max (nm)
• AMCA	349	448
• Cascade blue	400	420
• Coumarin	384	470
• Dansyl	340	520
• DAPI	359	461
• Dialkylaminocoumarin (375/470)	375	470
• Dialkylaminocoumarin (435/475)	435	475
• DIPI	364	455
• Hoechst	346	460
• Pyrenes	341	376
• Acridine Orange (DNA)	487	520
• BOBO-1	462	481
• Bodipy-fl	505	513
• CY2	489	506
• Dabsyl chloride	335	536
• DiOC6(3)	484	501
• DiOC7(3)	482	504
• DTAF	493	518
• ELF-97	345	530
• Eosin	524	544
• Eosin F3S	535	542
• FITC	494	518
• GFP	395 / 470	509
• Hydroxystilbamidine(fluorogold)	385	536
• IANBD amide	478	541
• Lucifer yellow	428	533
• MitoFluor green	489	517
• MitoTracker green	490	516
• Oregon green 488	493	520
• Oregon green 500	503	522
• Oregon green 514	511	530
• Rodamine green	502	527
• Rhodol green	499	525
• SYTO 16	488	518
• TOPRO-1	515	531
• TOTO-1	514	533
• YOPRO-1	491	509
• YOYO-1	491	509
• Bodipy R6G	528	550
• Bodipy 530/550	534	554
• Bodipy TMR	542	574
• Bodipy 558/568	558	569
• Carboxyrhodamine 6G	520	546
• CY3	550	565
• DiA	491	590
• Dichloro-dimethoxyfluorescein	522	550
• DiI	547	565
• JOE	525	555
• B-Phycoerythrin	546 / 565	575
• R-Phycoerythrin	565 / 546 / 480	578
• POPO-3	534	570
• POPRO-3	539	567
• Rhodamine 6G	525	555
• SYTO 25	521	556
• TAMRA(carboxytetramethylrhodamine)		
• TRITC(teramethylrhodamine isothiocyanate)	544	572
• BoBo-3	570	604
• Bodipy 576/589	576	590
• Bodipy 589/617	589	617
• BOPRO-3	575	599
• Chromomycin A3	458	590
• Cy3.5	581	596
• Dihydroethidium	518	605
• DIOC2(5)	579	601
• DiQ	562	600
• Ethidium Bromide	510	595
• Ethidium homodimer-2	528	617
• Hexidium iodide	518	600
• Lissamine rhodamine B	570	590
• MitoTracker red	578	599
• Propidium iodide	536	617

fluorochromes and stains	Excitation Max (nm)	Emission Max (nm)
• Radiant redTM	500	610
• Rhodamine Red	570	590
• Texas red	587	602
• Texas red-X succinimidyl ester	583	603
• XRITC	572	596
• Acridine orange (RNA)	487	650
• Allophycocyanin	650	661
• 7-aminoactinomycin D	555	655
• Bodipy 630/650	630	650
• CY5	650	670
• LDS 751	543	712
• Napthofluorescein	598	668
• TOPRO-3	642	661
• TOTO-3	642	660
• CellTracker Blue	353	466
• DAPI	359	461
• DPH	354	430
• Fura-2		
• Hoechst	346	460
• Hydroxycoumarin 385/445	385	445
• Hydroxycoumarin 360/455	360	455
• Indo-1	335	405 / 490
• Laurdan	364	497
• LysoSensor Blue DND-192	374	424
• Methoxycoumarin	340	405
• Prodan	361	498
• BCECF	439 / 490	530
• Bilirubin	452	525
• Bodipy FL brefeldin A	503	510
• Calcein	494	517
• Calcium green	506	533
• Carboxyfluorescein	492	517
• CellTracker Green Bodipy	522	529
• CFDA	494	517
• Cl-NERF	518	544
• DiOC5(3)	484	500
• DiOC16(3)	484	501
• DM-NERF	515	542
• Fluo-3	506	526
• 5 hexadecanoyl fluorescein	497	519
• JC-1 (low)	514	529 / 590
• LysoSensor Green DND-153	442	505
• LysoTracker green DND-26	504	511
• NBD-C6 ceramide	466	536
• Rhodamine -123	505	533
• Stachyose fluorescein	491	516
• Calcium orange		
• DiC18(3)	549	565
• DiC16(3)	549	565
• LysoTracker Yellow DND-68	534	551
• MitoTracker Orange	551	576
• Octadecyl Rhodamine B	556	578
• Rhodamine B Hexyl ester	556	578
• SNARF (Acid)	490	580
• Tetramethylrosamine	550	574
• Bodipy TR ceramide	589	617
• DASPMI	475	605
• DiA	491	590
• DiD	644	665
• DiQ	562	681
• FM1-43	510	626
• LysoTRacker Red DND-99	577	590
• SNARF (Base)	490	630
• Sulforhodamine 101	586	605
• Sulforhodamine B	565	586
• Sulforhodamine G	529	548
• Sulfonerhodamine Bis-(PEG 2000)	557	581
• Fura red	436 / 500	640
• Napthofluorescein	605	675
• RH-414	532	716

Other Radio and sizes are available upon request

Interference Band Pass Filter

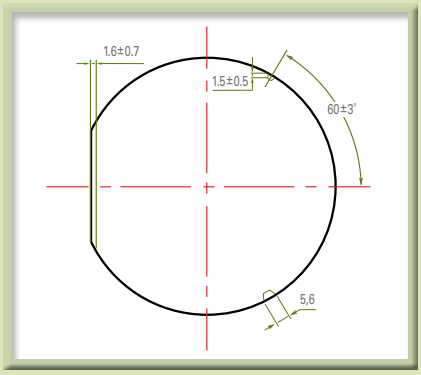
Infrared Filter
Gas Analysis Filter

▶ Application

Infrared absorption (NDIR) gas sensing, Environment management system

▶ Property

Technology is based on infrared (IR) absorption of radiation called the NDIR(Non – Dispersive Infrared) technique. By detecting the amount of light absorbed, within just a narrow band width that coincides with the resonance wavelength of the specie selected, one gets a measure of the number of molecules, free from interference of other species.



▶ General Specification

- **Substrate : Silicon.**
  (Germanium Wafer, Sapphire Wafer, etc.)
  Dia. :100.00mm+0.30 / -0.30mm
  Thickness : 0.525mm+ / -0.025mm
  Durability test method
  – Humidity : MIL-C-48497A 4.5.3.2.
  – Moderate : MIL-C-48497A 4.5.3.3.
  – Adhesion : MIL-C-48497A 4.5.3.1.
- **Blocking specification can be design by custome**

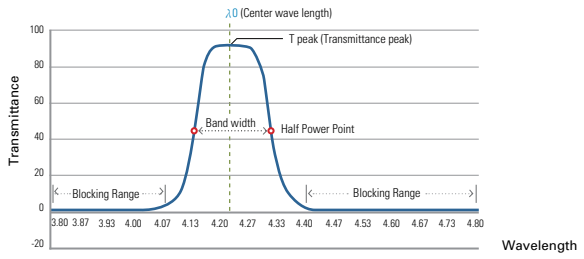
Infrared Narrow Band Filters are designed for the detection and measurement of atmospheric gases. Many gases show a specific absorption line in the mid to far infrared range. With a filter which allows the monitoring of this specific gas absorption, the measurement of gas concentration is possible.

▶ Ordering Information

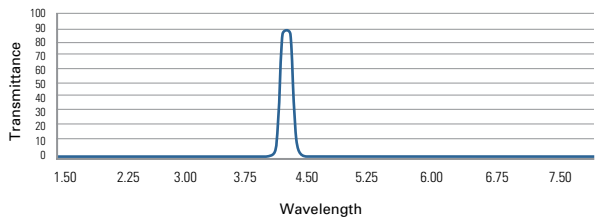
Model No	CWL (um)	Transmittanc	Bandwidth (nm)	Blocking (um)
NBPF - 3.09 - 160	3.09	70%	160	1.50 ~ 8.00
NBPF - 3.30 - 160	3.30	70%	160	1.50 ~ 8.00
NBPF - 3.33 - 160	3.33	70%	160	1.50 ~ 8.00
NBPF - 3.35 - 190	3.35	70%	190	1.50 ~ 8.00
NBPF - 3.95 - 90	3.95	76%	90	1.50 ~ 8.00
NBPF - 4.24 - 90	4.24	70%	90	1.50 ~ 8.00
NBPF - 4.26 - 90	4.26	76%	90	1.50 ~ 8.00
NBPF - 4.26 - 180	4.26	76%	180	1.50 ~ 8.00
NBPF - 4.33 - 160	4.33	73%	160	1.50 ~ 8.00
NBPF - 4.40 - 700	4.40	80%	700	1.50 ~ 8.00
NBPF - 4.43 - 60	4.43	70%	60	1.50 ~ 8.00
NBPF - 5.48 - 850	5.48	76%	850	1.50 ~ 10.00
NBPF - 7.30 - 180	7.30	70%	180	1.50 ~ 10.00
NBPF - 10.27 - 210	10.27	65%	210	1.50 ~ 14.00
NBPF - 11.30 - 200	11.30	70%	200	1.50 ~ 14.00
NBPF - 12.40 - 180	12.40	65%	180	1.50 ~ 14.00

Other Radio and sizes are available upon request

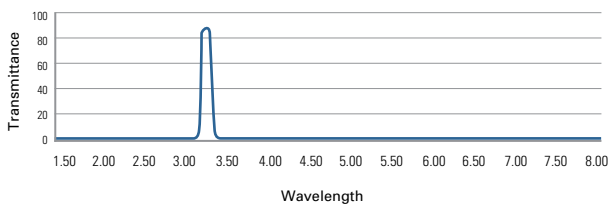
Technical information



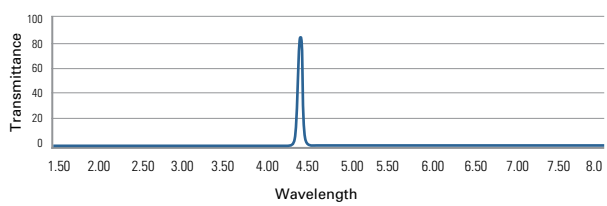
NBPF 4260-180nm



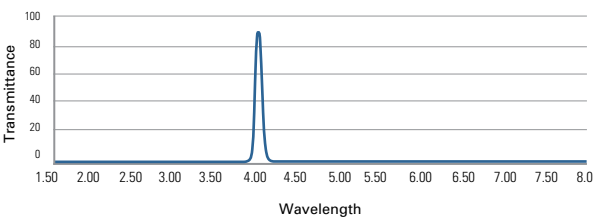
NBPF-3330-160nm



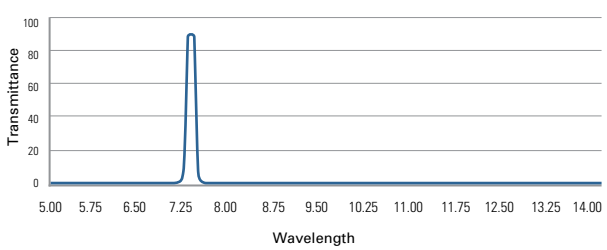
NBPF-4430-60nm



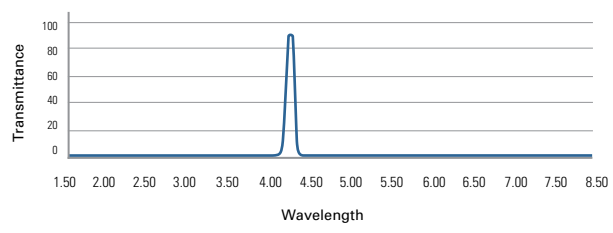
NBPF-3950-90nm



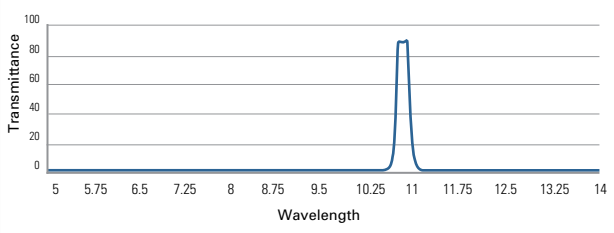
NBPF-7300-180nm



NBPF-4260-90nm



NBPF-1027-210nm



Infrared Long Wave Pass Filter

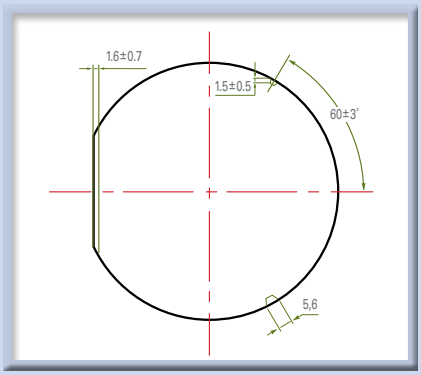
Infrared Long Wave Pass Filter
Motion / Intrusion Filter

▶ Application

Industrial temperature measurement, Continuous temperature control for manufacturing, Security system, Radiation monitor.

▶ Property

Most of Blocking at range under 5um wavelength in order to reduce the noise, High transmittance at range 7.5~14um wavelength in order to make higher sensitivity of the sensor.



▶ General Specification

- **Substrate : Silicon.**
  (Germanium Wafer, Sapphire Wafer, etc.)
  Dia.100.00mm+0.30/-0.30mm
  Thickness: 0.525mm+/-0.025mm
- **Cut on , Cut off : Wavelength of 5% Absolute** transmission Durability test method
  - Humidity : MIL-C-48497A 4.5.3.2.
  - Moderate : MIL-C-48497A 4.5.3.3.
  - Adhesion : MIL-C-48497A 4.5.3.1.
- **Blocking specification can be design by customer**

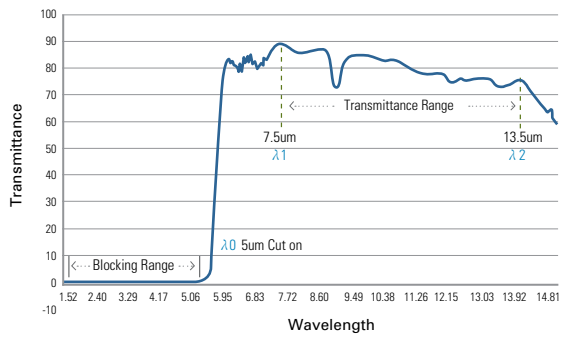
Infrared Long wave pass filters are designed to transmit wavelength longer than their specified 5% cut-on wavelength and to block shorter wavelength than their specified 5% cut-on wavelength. Infrared Long Wave Pass Filter and Infrared Wide Band Pass Filters are commonly used for Motion and Intrusion sensor. The filters are designed with the specification of less than 0.1% in average and Less than 1% in absolute for blocking in order to minimize noise. The filters can come in different sizes based on customer's requirements.

▶ Ordering Information

Filter Number	Cut-on(um)/ T=5%	Transmittance		Blocking	
		Range(um)	Averge(%)	Averge(%)	Range(um)
ILWP - 5.0	5.0	7.5 - 13	> 75	Ave. < 0.1	vis ~ 4
ILWP - 5.5	5.5	7.5 - 13	>75	Ave. < 0.1	vis ~ 4.5
ILWP - 6.6	6.6	7.5 - 13	>75	Ave. < 0.1	vis ~ 6
ILWP - 8.0	8.0	9.0 - 13	>75	Ave. < 0.1	vis ~ 7
WBPF 8-14	Cut on 8.0 Cut off 14.0	9.0 - 13	>75	Tabs < 1% Tave < 0.1% Tave <0.1%	vis~4 4um~7 cut off ~20

Other Radio and sizes are available upon request

Technical information



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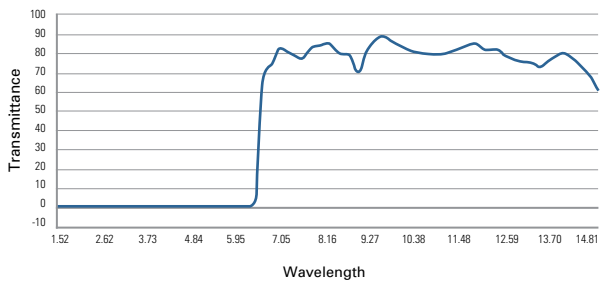

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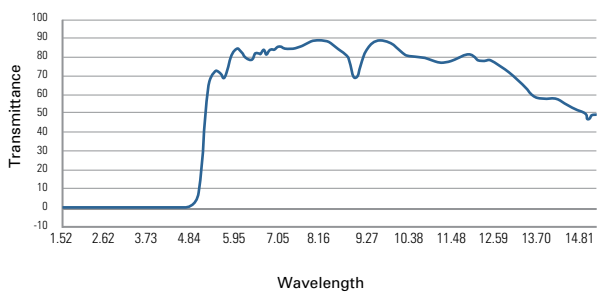

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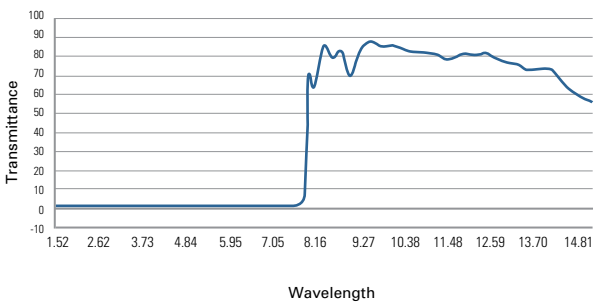

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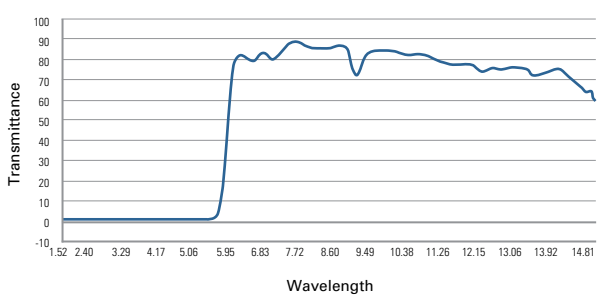
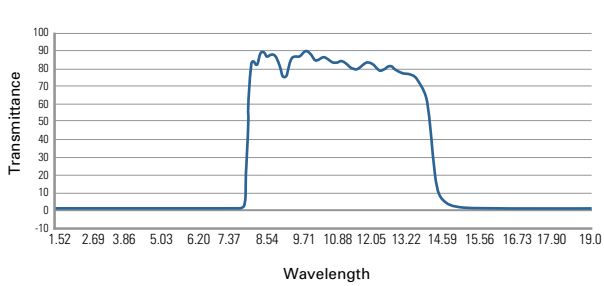
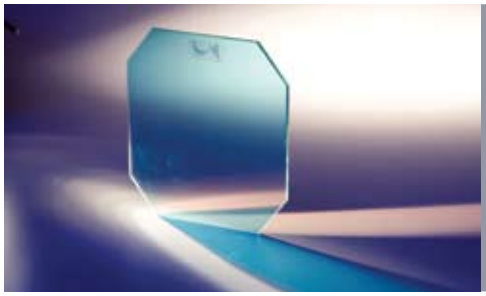


Wide Band Pass Fiter (8-14um)



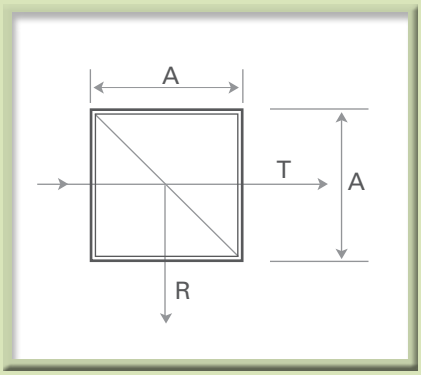
Beam Splitter



Non Polarizing Beam Splitter
Broad Band Beam Splitter

▶ Physical Specifications

- Material : BK7
- Dimensinal Tolerance : + 0.1mm
- Surface Quality : 40-20
- Surface Accuracy : 1/8λ
- Angle Tolerance : ± 2 arc min
- Clear Aperture : 90%
- Bevel : 0.3mm 45



▶ Non Polarizing Beam Splitter

TECH SPEC NON-POLARIZING VISIBLE AND NEAR IR HYBRID BEAMSPLITTERS

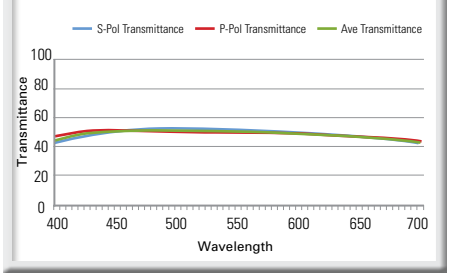
The low polarization dependence of the metallic/dielectric hybrid coating allows the trans-mission and reflection for S and P Polarization states to be within 6% of each other. These beamsplitters are also spectrally flat across the specified flatness also reduces the effects due to changes in the angle of incidence or converging/diverging beams. Each beamsplitter consists of a pair of precision high tolerance right angle prisms cemented together with a metallic-dielectric coating on the hypotenuse of one. A broadband antire-flective (BBAR) coating has been applies to each face of the beamsplitter in order to pro-duce maximum transmission efficiency. Two different wavelength ranges are available. 400-700nm and 700-1100nm.

▶ Ordering information

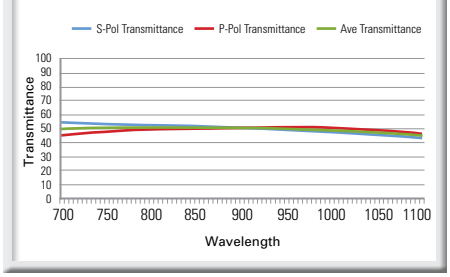
Design Wavelength	430-670nm, Visable	720-1080nm, Near IR	1100-1620nm, Telecom
Coating Type	Hybrid	Hybrid	Dielectic
AR Coating	BBAR@550nm	BBAR@900nm	BBAR@1320nm
Trancemittance	45%±5%	45%±5%	45%±5%
Reflection	45%±5%	45%±5%	45%±5%
Absorption	< 10%	< 10%	N/A
Polarization	< 6%	< 6%	N/A

Other Radio and sizes are available upon request

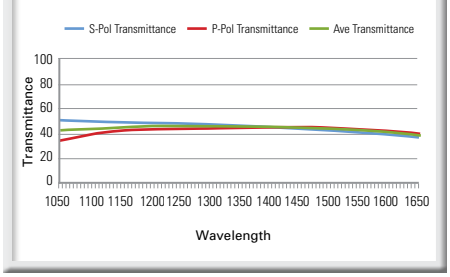
Visible Non Polarizing Beamsplitter



NiR Non-Polarizing Beam splitter



Telecom Cube Beam splitter



▶ Broad band Beam Splitter

Broad band Beam Splitter is typically specified by the ratio of transmission to reflection. Seoul Precision Optics can supply Beam Splitter at any required ratio and for any common laser beam.

▶ Ordering information

Filter Number	R/T	Wavelength Range(mm)
BBS-80/20-	80/20	450-650
BBS-70/30-	70/30	450-650
BBS-60/40-	60/40	450-650
BBS-50/50-	50/50	450-650
BBS-40/60-	40/60	450-650
BBS-30/70-	30/70	450-650

Other Radio and sizes are available upon request

▶ General Specification

- Substrate : BK7
- Size Tolerance : +/- 0.1mm
- Thickness : 2.0mm(nominal) to 3.0mm
- AR Coating : <0.25 % per face
- Angle of Incident : 45 degree

* Specification can be design by customer

Anti-Reflection

IR Anti Region

▶ Anti-Reflection

coating minimize surface reflection from optical systems.
Generally, there are three types of Anti-Reflection.

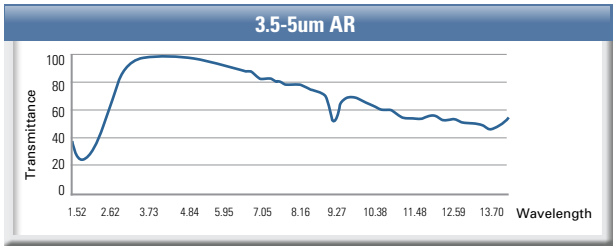
▶ Broad Band Anti-Reflection (IBAR in infrared)

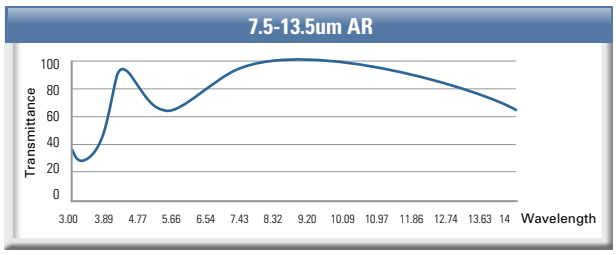
is used in many optical element in systems on sensor. This coatings are characterized by very low anti reflection in broad spectrum range.

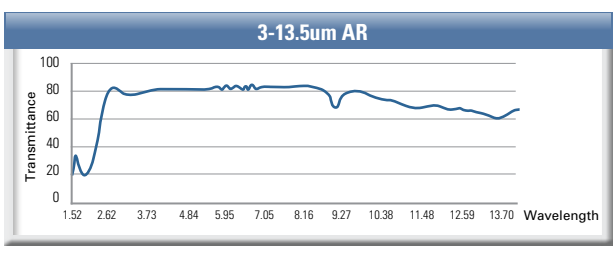
▶ Ordering information

Filter Type	Transmittance		Substrate
	Range(um)	T. Ave.	
IRAR-3.0	3~ 13.5	74%	Silicon
IRAR-4.24	4.24	97%	Silicon
IRAR-3.5	3.5 ~ 5	95%	Silicon
IRAR-7.5	7.5 ~ 13.5	95%	Germanium. ZnS

Other Radio and sizes are available upon request







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PRECISION

OPTICS

Seoul Precision Optics Sales Staff will be happy to answer any questions you have about our products. While most of our inventory can be delivered the next day, we specialize in prototyping and manufacturing the optics you need. To e-mail your questions, please use the appropriate addresses below.

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