


# OPTICAL FILTERS





## Optical Filters

Optical filters have always been an important part of the product range at LASER COMPONENTS. The overall demand for these products has not changed much through the decades, but the performance requirements have grown significantly. In close cooperation with our trusted and capable long-term partners we do our best to fulfil our customers' wishes – no matter how demanding your project is.



We have the technologies to cover wavelengths from UV (~220nm) to NIR (~2µm) and even the far IR (~20µm). With the use of hard coatings, we have the possibility to offer you high quality standard designs with transmission values of more than 90% and average blocking at optical densities above 4 over the whole range of 200–1200nm. Higher blocking wavelengths are possible depending on the position of the passband. In some cases, we may technically achieve transmission values of ~98% and more as well as optical densities higher than 10. These designs also offer a long-term stability of more than ten years.

The broad set up of our machine park allows us to realize single piece as well as large series production from UV to IR. We are constantly investing in order to push our designs far beyond the previous limits. For many years, we have built up an extensive know-how in filter design, from which you can benefit today. A special strength of our coating department are ultra-narrow bandpass filters. They are produced using a wafer-based process, which allows us to offer a high amount of flexibility regarding mechanical dimensions and supply customized sizes in addition to the standard diameters like 12.5/25 or 50mm.

**Send us your requirements and together we will find the perfect filter solution!**





Alluxa

## Company Brief: Alluxa, Inc.

### General Information:

- Founded in 2007 in Santa Rosa, California.
- High performance, next generation thin films with industry leading technology
- Over 20 identical coating systems with automated processing
- Highest volume coating platform capable of running up to twenty-five 250mm wafers at a time
- Proven team of thin film experts with 75 employees

With a new class of custom optical thin-film coating equipment designed and built internally allows Alluxa to reliably and repeatedly reproduce the same high-performance optical thin films over several different coating runs, which translates to consistent performance across all their systems. Alluxa's rapid, custom design approach allows each product to be completely optimized to your system. Whether needed in large or small volumes, these custom thin films will allow your system to reach its full potential in both performance and cost.

To accommodate their continued growth, Alluxa is working on an expansion for additional manufacturing and office space. Alluxa's copy exact philosophy allows all machines to produce all products identically while improving maintenance cycles, repair effort, and machine uptime.





### Technology Advantages:

- Novel proprietary deposition platform
- Versatile technology in 20 identical coating chambers – every chamber can make every product, special MIR chamber
- Faster cycle time (3x faster than IBS)
- SIRRUS plasma PVD deposition process
- Extraordinarily durable, hard oxide coatings
- Next generation high S/N optical monitoring
- Ultra-precise layer deposition
- Emphasis on metrology and test data throughout the entire manufacturing process to ensure high quality
- 24/7, fully automated operation with clean operations throughout

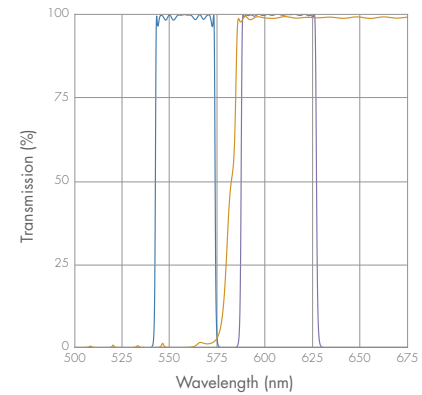
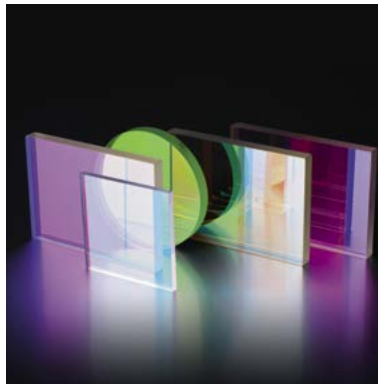
### Quality and Reliability:

- ISO 9001 certified
- ITAR compliant / registered
- High reliability coatings - All “hard” coating materials, coatings qualified to MIL 810 / MIL 48497, Telcordia GR-1221 qualified in telco market

### Facility:

- Automated Elma ultra-sonic cleaning
- Automated glass coring and singulation
- Automated laser marking
- Automated spectroscopy





Cy®3.5 fluorescence filter set for LED light sources with OD6 blocking

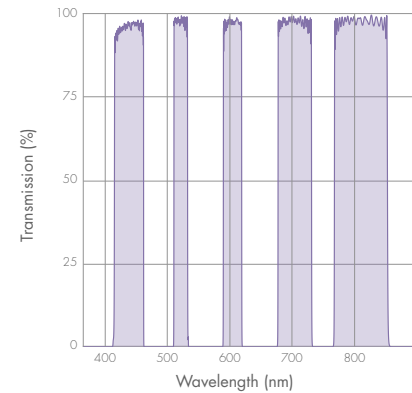
### Metrology and Quality:

- Cary 6000/5000 Spectrophotometer (x5)
- Cary FTIR spectrophotometer
- Keyence dimensioning microscope
- Zygo verifire interferometer

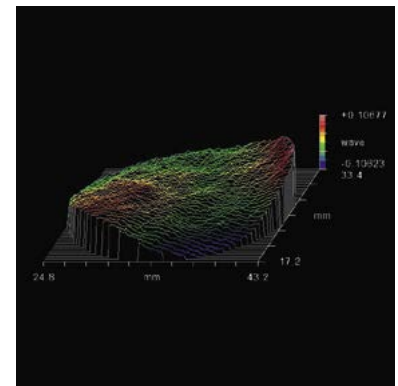
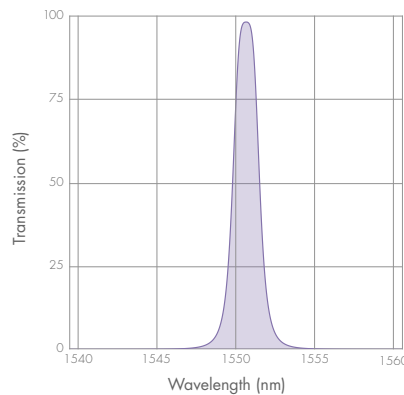
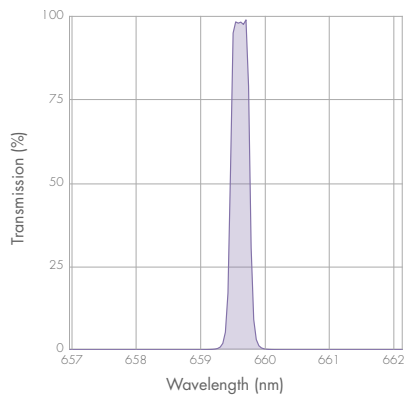
Using the HELIX spectral analysis system (a new industry-leading optical spectrophotometric capability), it's possible to resolve bandwidths of less than 0.1 nm and obtain precise and accurate measurements of their steepest edges traced to beyond OD7.

### Applications/Samples:

- Life Sciences including cytometry, microscopy and DNA sequencing
- Ultra filters for fluorescence: high performance with very steep edges and tight wavelength tolerances
- Confocal / DNA sequencing / single molecule DNA
- Single and multiband exciter, emitter, and dichroic
- Notch / multi notch / laser line, phase control / ultra-flat surfaces



Bandpass filter single side coating with OD4 blocking



**Ultra Narrow Bandpass Filters** are ideal for use as laser line, laser cleanup, or laser excitation filters in applications such as fluorescence microscopy, flow cytometry, and DNA sequencing. Alluxa is the only manufacturer offering FWHM bandwidths as narrow as 0.1 nm

- Up to >98% peak transmission
- Fully blocked out of band range up to OD10 by design
- Multicavity designs for square spectral performance
- CWL tolerances as tight as 0.05 nm or less
- Transmitted Wavefront Error (TWE) as low as 0.01 wave RMS/inch (measured at 632.8 nm)

### Ultra Narrow NIR Filters for Communication

- Highest peak transmission >90% (95% typical between 1000 nm and 2000 nm)
- Fully blocked - OD3, OD4, or OD6 from 200 nm to 2000 nm (30 dB to 60 dB)
- 'Squarest' passbands in the industry 2, 3, 5, 7+ cavity filters
- Specializing in large formats  
Diameters up to 300 mm

### Low Stress Manufacturing Process

When a thin-film coating is deposited onto a substrate, the stress of the coating causes the substrate to bend. This coating stress induced curvature can result in image distortion. Traditionally, this curvature can be minimized by the use of a thicker substrate or by a backside compensation coating. However, both of these options come with drawbacks. Therefore, Alluxa has developed a low-stress manufacturing process that produces ultra-flat dichroics and mirrors without the need for backside compensation. The dichroic filter in the figure above refers to another dichroic which is identical in terms of spectral response, coating thickness, and both substrate thickness and material. However, the filter produced using the low-stress process is flatter by nearly one order of magnitude than the filter manufactured using standard methods.



## Company Brief: Northumbria Optical Coatings Ltd.

### General Information:

- Privately owned
- Established in 1995 and located in Boldon, UK
- Specializing in design and manufacture of infrared optical dielectric filters and coatings for the range  $\sim 2-20\mu\text{m}$
- Factory expanded to a total of 10,000sqft
- 12 coating machines
- In-house processes – thin film coating, polishing, and cutting of optical materials
- Coatings from  $2 \times 2\text{mm}^2$  square up to  $\text{Ø} \sim 130\text{mm}$  depending on coating type, typical  $\text{Ø} 25.4\text{mm}$
- Custom sizes cut as required to different shapes as thin as 0.3mm and as thick as 10mm
- Proven team of long term thin film experts with 28 employees
- Web Shop with currently over 2,500 filters listed

### Technology Advantages:

- Blocking levels: visible wavelengths blocked as standard. Longer wavelengths depend on substrate type and thickness, however  $>10\dots 20\mu\text{m}$  possible on Germanium
- High efficiency multi-layer broadband coatings with  $>95\%$  avg transmission
- R&D/prototype services

### Quality and Reliability:

- EN ISO 9001:2015 quality management system
- Coatings qualified to MIL-F-48616 norm





### Metrology and Quality:

- 4x spectrophotometers covering 200nm to 50µm (Nicolet IS50)
- Automated optical measurement to increase throughput for large volumes
- Specially designed mechanical angle testing device to test at any angle
- Cryo-stat for optical transmission measurements at cryogenic temperatures
- Zygo interferometer for measurement of surface flatness, wave front error and parallelism
- Trioptics Auto Collimator for non-contact measurement of angular displacements
- Mitutoyo Manual Vision Measuring Machine
- Environmental chamber for testing to extreme levels of temperature and humidity

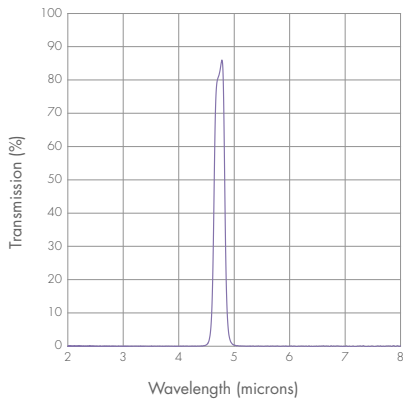
### Facility:

- Machines in-house for edging, milling, lapping and polishing of substrates
- 12x coating chambers ranging from 500mm to 1100mm – a range of chamber sizes give flexibility to manufacture bespoke products
- Dicing department with automated and semi-automated cutting technology (x3)
- Vacuum leak detection equipment – manufacturing issues can be identified and resolved before they are able to impact workflow

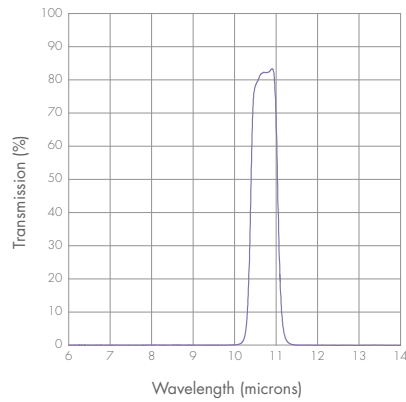
### Typical Markets:

- Environmental monitoring
- Analysis and control of gaseous effluent from power stations
- Security systems
- Analysis of vehicle exhaust gases
- Sensing instruments
- Spectroscopy
- Thermal imaging
- Space applications
- Mine safety equipment
- Medical devices
- Marine emissions monitoring
- Flame detection
- Solar radiation
- Defence
- Automotive

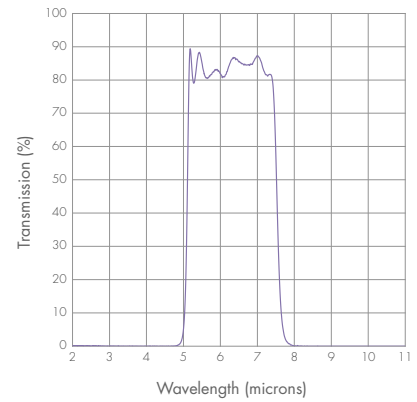




**Narrow Bandpass Filters** are designed to isolate a narrow region of the infra-red spectrum. This is accomplished using a complex process of constructive and destructive interference. Narrow band pass filters have bandwidths (measured at half-peak transmittance levels) less than 6% of the centre of wavelength value. When ordering, the bandwidth can be expressed as a percentage of the centre wavelength, or can be given in microns. The filters exhibit high peak transmission (typically greater than 60%) combined with high attenuation levels outside the passband (typically less than 0.1%).

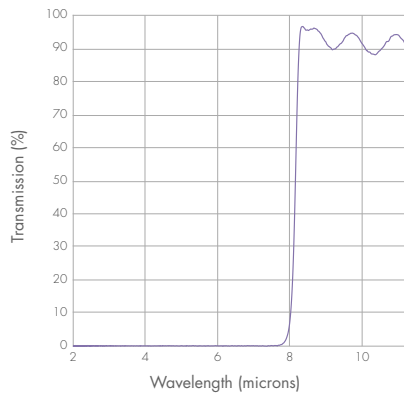


**Bandpass Filters** are designed to isolate a relatively wide spectral band. They are classified by having bandwidths (measured at half-peak transmittance levels) between 6% and 13% of the centre wavelength value. When ordering, the bandwidth can be expressed as a percentage of the centre wavelength or can be given in microns. The filters exhibit high peak transmission in the passband (typically greater than 70%) and very low transmission levels outside the passband (typically less than 0.1%).



This **Wide Bandpass Filter** highlights NOC's ability to create high wavelength filters while still maintaining the steep slopes and flat top that are becoming ever more important in the industry.

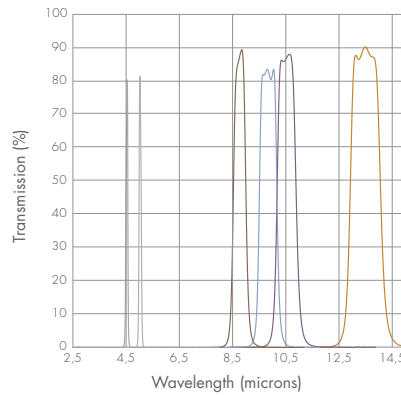
The filters exhibit high average transmission in the passband (typically greater than 70%) and very low transmission levels outside the passband (typically less than 0.1%). This type of filter is particularly useful for isolating the 3–5 $\mu\text{m}$  or 8–12 $\mu\text{m}$  atmospheric windows and finds widespread use in thermal imaging/human body sensor applications.



**Long Wave Pass Filters** (also referred to as edge filters) are constructed from stacks of thin layers. They are distinguished by a sharp transition from a zone of rejection to a zone of transmission. The rejection region extends to below  $0.3\mu\text{m}$  and the transmission region typically extends to greater than twice the wavelength of the edge position.

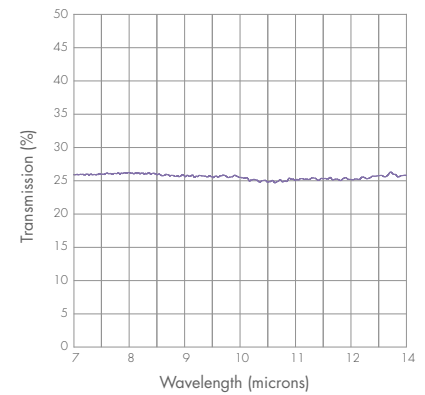
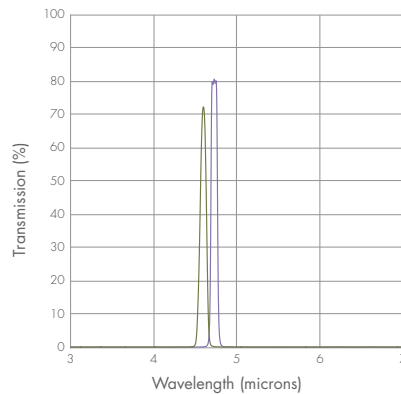
#### IR Semiconductor Filters

These are not strictly speaking thin film filters but are based on the band structure of the semiconductors. The material is AR coated + polished and available in Si, GaAs, Ge or InAs.



**Specials.** A range of special purpose narrow band filters for gas and vapour analysis are generally available ex-stock at very competitive prices. Specifications are based on general customer requirements and experience over many years, although tighter tolerances, different bandwidths and filters for other gas bands are available on request.

#### Beamsplitter $4.74\mu\text{m}$ at AOI $45^\circ$



#### IR Neutral Density Filters

Neutral IR gray filters are used for the broadband attenuation of infrared radiation, and are largely produced according to customer specifications. A metallic coating is responsible for the attenuation of light via reflection or absorption.

Depending on the required wavelength range (up to  $14\mu\text{m}$ ), substrates such as fused silica, sapphire, germanium, or silicon are used. IR ND filters are classified by optical density (OD) in the range from 0.1 to 2.0, and shape of the curve across the wavelength range can be considered as linear.

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**MASSIVE IMPACT**



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