

Stabilife[®] Optical Filters and Coatings



Stabilife[®] optical filters and coatings are manufactured using two patented processes for the deposition of metal oxide thin film optical coatings; Reactive Ion Plating (RIP) and Hybrid Plasma Enhanced Deposition (HPED). Both processes yield highly dense, thin film coatings with extraordinary hardness, abrasion resistance, and adhesion to the substrate. Our Stabilife processes have been in full-scale production at our Corion coating facility in Franklin, Massachusetts since the early 1990's.

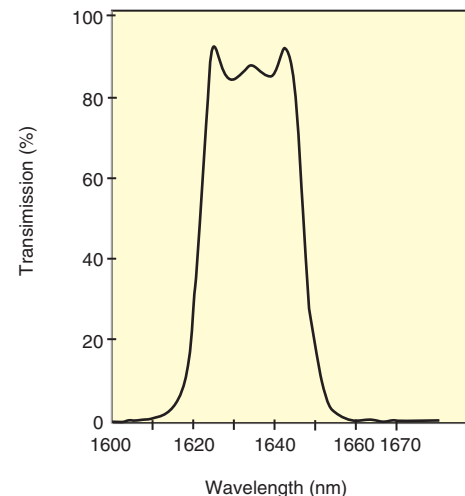
Spectral Stability

Optical components which directly affect the spectral performance of an optical system, must be able to deliver repeatable and accurate wavelength vs transmission response, regardless of the operating conditions. In some applications, un-stabilized metal oxide optical coatings or laminated soft-film coatings are adequate to meet the required performance parameters. However, for some of the more demanding applications such as fluorescence detection, wavelength stability is absolutely critical to insure dependable results. Stabilife optical filters and coatings provide the solution for these high accuracy applications.

Film Density & Spectral Stability

Film density is a critical factor affecting the spectral stability of an optical coating. Un-stabilized metal oxide thin film coatings typically exhibit a significantly lower packing density than Stabilife coatings. This occurs as a result of the intrinsic growth properties of the coating materials when deposited using methods which do not enhance film densification. The film structure of un-stabilized metal oxide film tends to be columnar with a significant number of voids. The presence of these voids contributes to the occurrence of environmentally induced spectral shift in un-stabilized external coatings. Changes in wavelength, which are influenced by the presence of voids, tend to be elastic in nature and depend upon the ambient relative humidity in which the coating is being used. The permeability of the film will determine the degree to which this phenomena will occur. Spectral shifts in the range of 2-5% of wavelength are typical of un-stabilized metal oxide coatings. Stabilife coatings have a higher packing density and lower void ratio than un-stabilized metal oxide coatings and are therefore less affected by water absorption. They typically exhibit total wet-to-dry shifts of less than 0.02% of wavelength.

Humidity Stability of Stabilife[®] Filters



Measured transmittance scans of a Stabilife filter at 0% and 100% relative humidity. Scans are exactly overlaid as no shift is discernible at the standard scan speed for a 30nm bandwidth filter.

Thermal Properties & Spectral Stability

Stabilife films are typically 5 to 10 times less sensitive to thermal variation than un-stabilized metal oxide films as a result of film densification. Temperature change functions as a catalyst for moisture migration in thin films having a significant volume of voids. When un-stabilized films are exposed to high temperatures, moisture migrates out of film voids contributing to the wavelength change discussed earlier. The high film density and reduced permeability resulting from the Stabilife processes reduces this effect providing the maximum spectral stability available for all types of precision coatings including bandpass, dichroic, edge, notch and polarizer coatings.

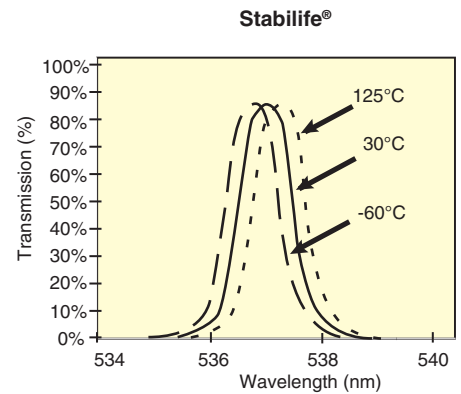
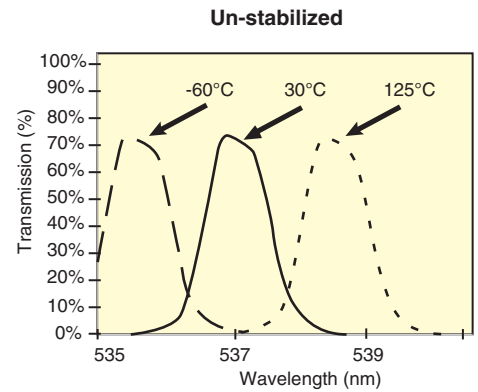
Physical Durability

Stabilife thin-film optical coatings have demonstrated excellent resistance to damage due to handling, extreme nuclear and optical radiation, and severe environmental conditions. In the most severe applications, such as autoclave immersed nuclear reactor monitoring, Stabilife® filters have demonstrated spectrally stable performance lifetimes exceeding 8,000 hours. Stabilife filters have been qualified for telecommunications applications per the requirements of Telcordia GR-2883. While most applications are much less demanding than these, the same robust coatings as are required for extreme applications, are routinely supplied for all Stabilife products. In the course of normal production, Stabilife films are tested for adhesion using the snap tape test specified in MIL-C-48497, for abrasion resistance using the eraser test specified in MIL-C-675, and for humidity resistance using the aggravated test specified in MIL-STD-810E. Stabilife thin-film optical coatings require no additional protection such as hermetic sealing using lamination or other processes, to achieve their exceptional durability.

Typical Applications

Stabilife films are produced over the wavelength range from 200 nm in the UV to 3 microns in the IR and have been utilized in a variety of applications including:

- Clinical Chemistry Systems
- DNA Analysis Systems
- Rangefinders
- Laser Safety Eyewear
- Paint Color Matching Systems
- Thermal Imaging Systems
- Confocal Microscopy Systems
- Flow Cytometers
- Environmental Monitoring Systems
- Endoscopes
- Moisture Measurement Systems



Measured temperature-induced wavelength shift of an un-stabilized metal oxide ultra-narrow bandpass filter compared to a Stabilife® ultra-narrow bandpass filter.

Coating Designs

Standard Designs

- Narrow bandpass filters
- Ultra-narrow bandpass filters
- Wide bandpass filters
- Notch (band-rejection) filters
- Dichroic filters (beamsplitters, polarizers, non-polarizing edge filters)
- Heat / UV rejection filters

Specialty Designs

- High efficiency laser mirrors
- Multiple-line rejection filters
- Color balancing filters
- Passivation coatings
- Conformal coatings

Product Examples

Narrow Bandpass Filters

Stabilife is an effective solution for bandpass filters from 200 nm to 2000 nm where thermal, environmental and spectral stability is of primary concern. Filter sizes can range from 0.100 inches to over 15 inches. Typical applications include filters for clinical laboratory instrumentation, color matching systems, and fluorescence detection systems.

Ultra-narrow Bandpass Filters

The exceptional spectral stability provided by Stabilife films is particularly important for applications requiring ultra-narrow bandpass filters. This quality, along with the low total loss of the films, combine to yield high transmittance ultra-narrowband filters with bandwidths ≤ 1 nm that require no active substrate temperature control during operation. Typical applications for ultra-narrow bandpass filters include filters for astronomical observation, point of care clinical chemistry systems, and environmental monitoring systems. Filters as large as 10 inches in diameter can be provided.

Wide Bandpass Filters

Stabilife wideband filters provide extremely steep spectral slopes and very high transmission, coupled with thermal and environmental stability for applications requiring wide filter acceptance angle and/or wide spectral transmission ranges. Wide bandpass filters are commonly used in fluorescence detection systems.

Dichroic Edge Filters

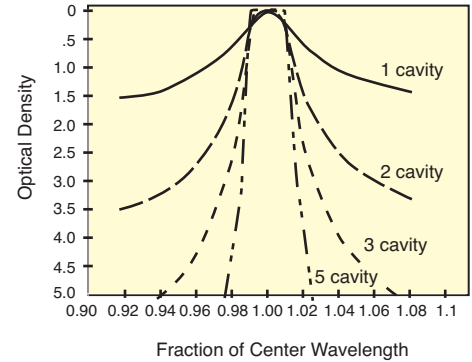
For applications such as fluorescence spectroscopy, steep-edged dichroic filters with enhanced temperature and environmental stability have been developed using Stabilife films. Newport's designs provide the very narrow transition zones necessary for small stokes-shift fluorophores. Paired with Stabilife excitation and emission filters, Newport provides fluorescence filter sets delivering superior spectral performance, spectral stability, and durability.

Stable UV Filters

Ultraviolet filters manufactured using Stabilife technology provide improved stability and lifetime over traditional UV bandpass filters by the inclusion of a band-defining component that requires no protection from environmental factors.

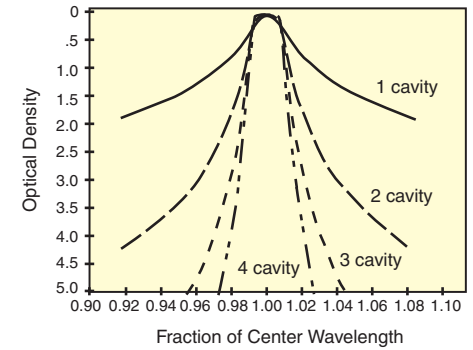
Excellent Stabilife film transparency combines with physical stability to improve transmission, wavelength precision, blocking, and of course, filter life. Stabilife narrow bandpass filters can be provided at wavelengths as low as 200 nm.

Narrow Bandpass Spectral Profile



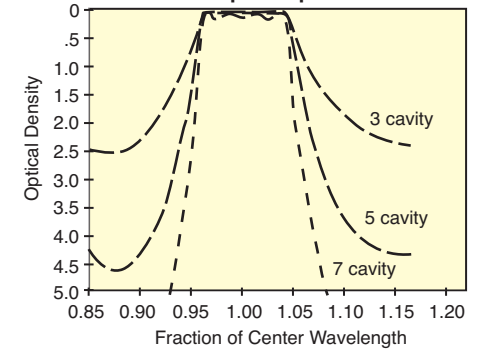
Spectral slopes and blocking characteristics of multi-cavity Stabilife narrow bandpass filters

Ultra-Narrow Bandpass Spectral Profile



Spectral slopes and blocking characteristics of multi-cavity Stabilife ultra-narrow bandpass filters

Wide Bandpass Spectral Profile



Optical density plot of Stabilife wide bandpass filters

Plastics and Semiconductors

Using our RIP Stabilife process, dense metal-oxide films can be deposited at near ambient temperature on a wide variety of temperature-sensitive substrates such as plastics and semiconductor wafers. Anti-reflection, conductive, and mirror coatings have been deposited on plastics such as polycarbonate, acrylic, and CR39®.

Scalability

In addition to enabling the production of highly stable films, the Stabilife processes are highly scalable. In comparison to other coating technologies that are capable of producing low-loss, spectrally stable coatings, the Stabilife processes are significantly less costly to scale up to very large coating areas per process cycle. Taking advantage of this feature, Newport has deployed both small and very large coating chambers to fulfill orders for Stabilife filters in quantities as small as one and as large as one million at competitive prices and at high monthly delivery rates for large quantity orders.



Newport's Stabilife Reactive Ion Plating Deposition System

Typical Stabilife Bandpass Specifications

Specification	Ultra-Narrowband	Narrowband	Wideband
Bandwidth (FWHM)	0.5 nm to 4 nm	5 nm to 20 nm	20 nm to 200 nm
Center Wavelength (CWL)	300 nm to 2 μm	200 nm to 2 μm	200 nm to 3 μm
CWL Tolerance (% of FWHM)	± 20%	± 20%	± 10 to 20%
Peak Transmittance	Up to 75%	Up to 80%	Up to 95%
Out-of-Band Blocking	OD4 to OD6	OD4 to OD8	OD4 to OD8
Cavities (typical)	2 to 3	3 to 5	4 to 8

Typical Stabilife General Specifications

Spectral Range	200 nm to 3.0 μm
Surface Quality	F/F (80/50) per MIL-F-48616 (typical); D/C (40/20) or C/B (20/10) achievable
Coating Hardness	MIL-C-48497
Coating Abrasion Resistance	MIL-C-48497
Coating Adhesion	MIL-C-48497
Coating Humidity Resistance	MIL-STD-810, Method 507.3, Procedure III, Modified to 40 cycles**
Coating Operating Temperature Range	-100 °C to 300 °C**
Filter Size Range	1 mm to 300 mm
Filter Thickness Range	0.5 mm to 20 mm

**The specifications for humidity resistance and coating operating temperature range listed above apply to exposed coatings only. Humidity resistance and operating temperature range of filters manufactured using Stabilife coatings and assembled using epoxy systems revert to the humidity resistance and operating temperature range of the epoxy system.



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