



SPECTOR[®] 100 GHz Upgrade

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Introduction

Veeco Instruments' **SPECTOR[®]** Optical Coating System leads the industry for thin film deposition of DWDM filters.

SPECTOR[®] has the capability to manufacture a variety of thin film filters including 100 GHz DWDM filters with uniformities better than 0.07%. These filters feature: wide passband, narrow stopband, steep slope, low insertion loss characteristics, environmental stability, low defects and high quality dense films.

As a continuing service to our customers, Veeco would like to share our experience with greater consistency and yield of 100 GHz DWDM filters. The recent improvements to the **SPECTOR[®]** system include:

- New high speed fixture with reduced wobble
- New substrate shield for reduced deflection
- New source alignment tools and techniques



Figure 1 High Speed Fixture

High Speed Fixture

Stringent requirements are imposed on the mechanical fixturing of the substrate, since the position of the transmittance peak for DWDM filters must be controlled to better than one part in ten thousand. Substrates must be spun extremely fast ($> 1,000$ rpm) to ensure azimuthal uniformity of the coating thickness. Also, wobble cannot be tolerated because it induces substrate displacement relative to the deposition source. A $45 \mu\text{m}$ substrate displacement would typically result in center wavelength (CWL) shifts of ~ 0.4 nm for DWDM filters. This amount of displacement is created by a wobble of 0.02° at a radial position of 115 mm.

Veeco has modified the design of the high speed fixture. The motor has been internalized to make the fixture more compact. The shaft of the new fixture has been redesigned with an integral rear hub. *With these feature upgrades the substrate mounting fixture can provide a wobble of less than 0.005° , ensuring control of the peak position to within 0.10 nm or ± 0.05 nm from the average CWL.* This enables the deposition of the most demanding DWDM filter designs.

The fixture is available for either 7 mm or 10 mm thick substrates. Other thicknesses are easily designed and delivered in a reasonable period of time.

Substrate Shield

Understanding the effect of substrate displacement on the control of the peak position or the uniformity of the coating is vital. Though IBD does induce stress in films, the technique provides very high quality films that offer improved environmental stability over competing techniques. Typically, $\text{SiO}_2/\text{Ta}_2\text{O}_5$ quarterwave stacks exhibit film stress of about -350 Mpa (compressive). Such levels of stress will bow the substrates and cause substrate displacements up to 90 μm at the deposition radius of about 125mm. Such target-to-substrate distance variation results in substantial thickness non-uniformity, which translates into reduced yield.

Masking the inside zone of the substrate with a shield is a simple way to minimize the effects of stress without modification of the **SPECTOR**[®] system or the deposition parameters. With the use of a specially designed Veeco shield, only the outside annular deposition zone, where filters are produced, will be coated. The center of the substrate remains uncoated to minimize the stress forces. Use of this shield reduces substrate bow and improves uniformity.

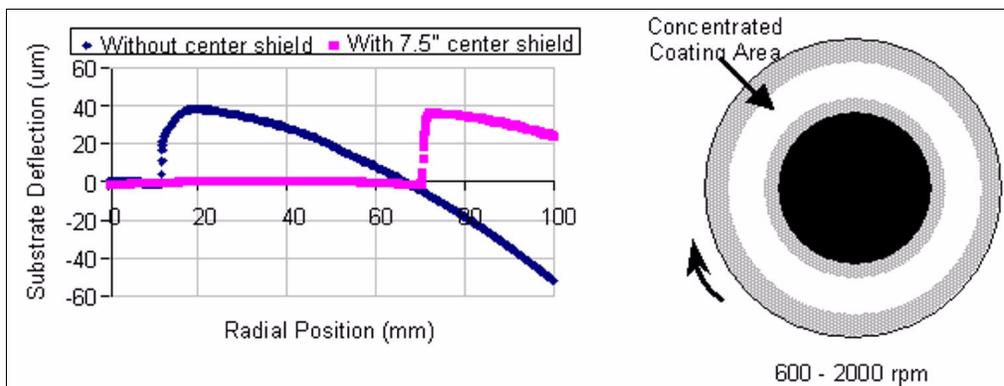


Figure 2 Substrate Center Shield

Source Alignment Tools and Techniques

Uniformity is key to acceptable yields for a DWDM filter run. One of the variables in achieving a good yield is the accurate and consistent alignment of the sources. System to system variations in alignment are possible due to slight differences in chamber geometry.

Because the assist source has the unique job of etching and packing the atoms on the substrate at the same time, the correct angle of incidence is important. Therefore, it is critical that the techniques used to align the assist source relative to the substrate be as accurate as possible. Experience with mechanical techniques has shown we can get the alignment close, but we have learned how to make it even better.

The new source alignment tool developed by Veeco assures repeatability from process run to run by using a laser to align the assist source within ± 1.5 mm of the ideal spot on the substrate. With the use of a laser to show where the 12cm source beam is hitting the substrate, it can be shown that an adjustment of 1/4 inch or less has an effect on the center wavelength.

The whole process typically takes less than 30 minutes and, because it is so easy to use, it can be included as part of a PM schedule. This device can also be used on the 16cm source to check the alignment with the targets.

Figure 3 shows the dramatic differences in the center wavelength profile when the 12cm assist source alignment is moved as little as 1/4 inch.

Summary

Performance is key in today's very competitive optical telecommunications market. You need every advantage you can get to improve your filter yields. Veeco is offering several options, including those discussed in this application note, to easily upgrade your **SPECTOR**[®] systems and improve your bottom line.

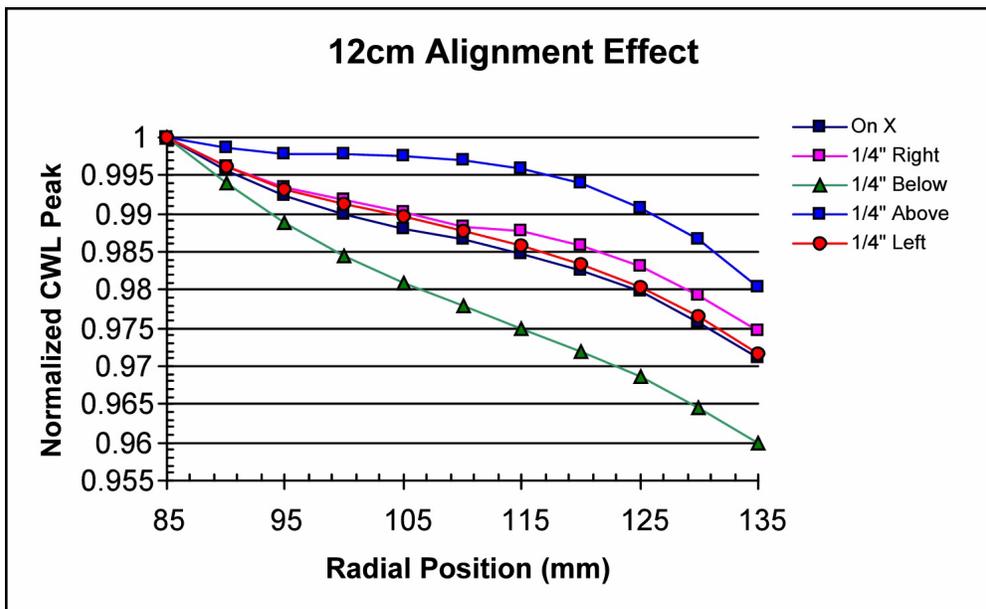


Figure 3 Effects of 12 cm Source Alignment





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