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Selection of Optical Fiber for Chromatographic Detectors and Remote Sensing Applications >

JOE MACOMBER AND RICK TIMMERMAN
POLYMICRO TECHNOLOGIES, A SUBSIDIARY OF MOLEX

Optical fibers are routinely used in liquid chromatographic detectors as a means of simplifying optical designs. Selection of the appropriate fiber is an important factor in achieving optimal system performance.

Introduction

Optical fiber has been used for many years in chromatographic applications which employ UV-Vis spectroscopy for sample detection. Fiber has allowed advances such as remote sensing, where in the “detection cell” no longer has to reside inside the detector itself, with dissolution sampling probes being a prime example. Important factors to consider when selecting a fiber are core size, –OH content, cladding thickness, potential bending radius and optical attenuation. Of special interest is the phenomenon of UV solarization, which occurs when the fiber absorbs high intensity radiation below 240nm and bonds within the glass structure are broken. The resulting “color centers” can exhibit strong absorbance which results in a marked increase in attenuation of the fiber (1). Alternately, many researchers would prefer to describe this as a decrease in light transmission.

Optical Fiber Attenuation in Deep UV

There are 3 key performance attributes to consider when comparing optical fiber for use in the deep UV. First is the initial attenuation of the fiber upon its first exposure to UV radiation. Secondly, the additional attenuation after initial exposure and a period of non-exposure referred to as recovery. And finally, the long term stability during and after repeated exposure.

Fiber Types Available

As most chromatographic analysis is done in the UV-Vis spectral range, designers typically use a high –OH fiber. There are four fiber options:

-FVP is the traditional high –OH fiber series and is excellent for applications at or above 240nm. Initial attenuation is significant at lower wavelengths due to rapid solarization.

-FVP-UVM offers moderate solarization resistance below 240nm. Even though it experiences solarization damage, after the initial exposure additional attenuation is minimal providing stable performance thereafter.

-FVP-UVMI is a Hydrogen loaded fiber series. It provides outstanding solarization resistance to below 200nm, but performance decreases dramatically once the Hydrogen diffuses out of the fiber. Life time is dependent upon Hydrogen content and therefore both the fiber diameter and operating temperature should be considered. (2) This fiber type is thus limited to larger diameter fiber, i.e. 400µm core or larger. Note that once the Hydrogen diffuses out it behaves like FVP-UVM fiber.

-FDP fiber undergoes a series of proprietary processing steps and offers excellent solarization resistance without the concerns related to Hydrogen diffusion. It has excellent lifetime and superior long term stability with only minimal initial attenuation loss. It is the fiber of choice for most deep UV applications, especially when smaller diameter fiber is required.

Fiber Comparison

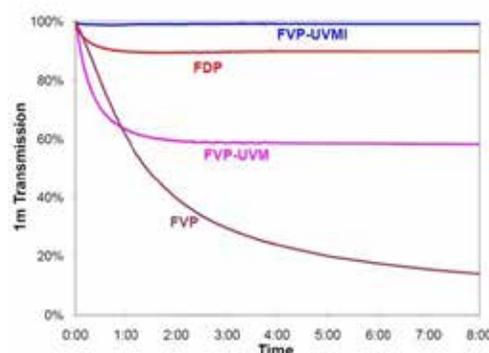


Figure 1: Effect of UV radiation on initial transmission.

Figure 1 displays a transmission comparison of the fiber types available during initial exposure to 214nm Deuterium radiation. Additional data on longer term exposure, recovery and overall stability were also collected.

Conclusion

This note discusses solarization of optical fiber and provides recommendations for selecting the most appropriate fiber type for UV-Vis applications. For additional information or assistance with your specific application, please contact a Polymicro Technical Sales Specialist.

References

- (1) J.Zhou, J.Shannon & J.Clarkin, *Biophotonic International*, (2008), 42-44
- (2) K.-F.Klein, R.Kaminski, S.Hüttel, J.Kirchhof, S.Grimm, G.Nelson: *SPIE-Proc. Vol. 3262C* (BiOS 98), pp. 150-160 (San Jose, Jan. 1998)

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