MicroNIR™ Sampling Distance

Near-infrared spectroscopy (NIRS) is a desirable tool due to its unique ability to measure a wide range of different material types such as powders, liquids, solids, and slurries, often with no sample preparation. Users are able to measure these materials in their current states, saving analysis time and increasing sample analysis throughput. However, when developing a NIR method, careful consideration should be taken to ensure the sample presentation to the MicroNIR is optimized. The primary factor influencing NIR spectra is the distance from the sample being measured to the spectrometer input.

The MicroNIR has two integrated tungsten lamps, each of which has its own illumination field that overlaps with the other to create a sweet spot of photometric intensity. Light intensity on the sample is the highest at approximately 3 mm from the spectrometer window. At this distance, spectral scans have the highest signal-to-noise ratio at the lowest integration time. Figure 1 shows a typical MicroNIR photometric response with respect to distance away from the spectrometer window.

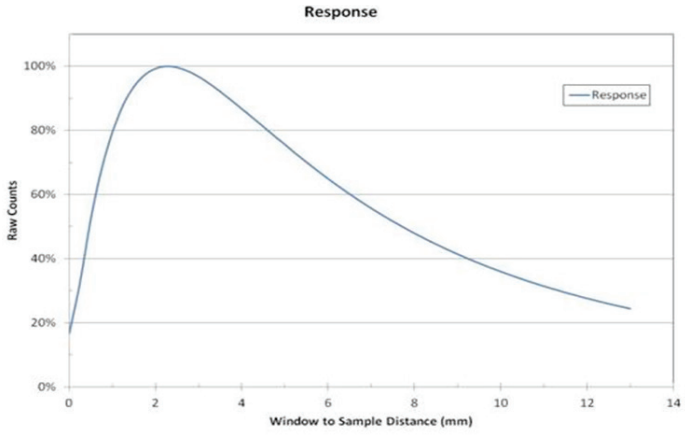

Figure 1. MicroNIR photometric response with respect to distance from window

Figure 2 shows the MicroNIR positioned at various distances from a sample. As the distance increases between the MicroNIR window and the sample, the effective analysis spot also increases. However, as this distance increases, light intensity reaching the sample decreases, which in turn causes a drop in spectrum signal-to-noise if the spectrometer integration time isn't properly adjusted to account for the loss in photometric intensity. To provide an example of this loss in photometric intensity, Figure 3 shows the raw counts of a 99% diffuse reflectance panel at a fixed integration time of 10.9 ms across multiple sample-to-spectrometer window distances.

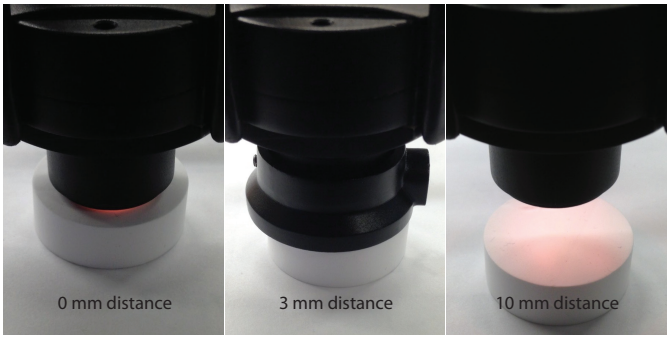

Figure 2. MicroNIR lamp illumination at 0 mm, 3 mm (with collar), and 10 mm distances from a sample

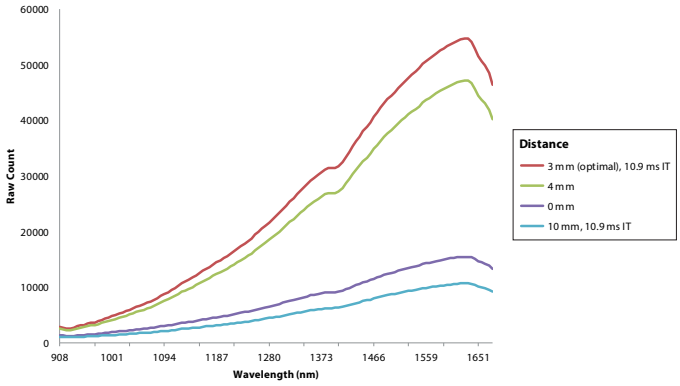

Figure 3. Raw count scans at different spectrometer-to-sample distances with a fixed integration time (IT)

Changing the sample distance without optimizing the integration time results in a significant drop in raw counts which, in turn, causes the lower signal-to-noise ratio in the NIR spectrum. To correct this phenomenon, once the desired sample to window distance is set, users should select a higher integration time to recover the drop in raw count signal. Figure 4 shows the same set of raw count scans with an additional scan representing a 10 mm distance using a 66.9 ms integration time versus the former 10.9 ms integration time.

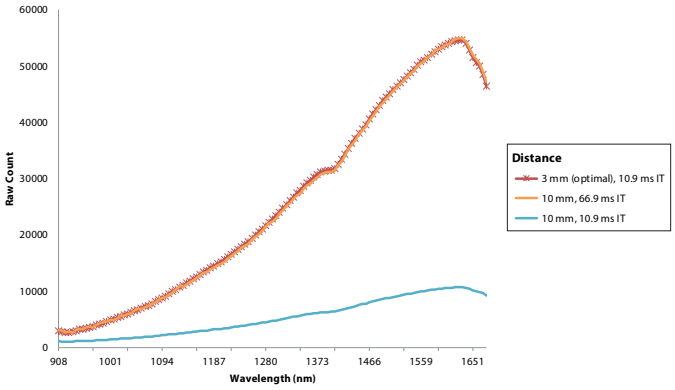

Figure 4. Raw count scan at 10 mm distance and 66.9 ms new integration time

Taking proper care to optimize the integration time at larger spectrometer-to-sample distances yields an overall improvement in raw counts and subsequent spectrum quality.

The Viavi MicroNIR spectrometer measures using a range of sample-to-spectrometer distances, or focal points. Proper care must be taken to optimize spectrometer integration time depending on the sample-to-spectrometer distance being used to ensure the highest spectrum quality and subsequent performance in calibration model development.

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