What is the difference between a reflectance and an absolute reflectance measurement?

FTIR measurements require collection of a single beam sample spectrum (I_s) and a single beam background spectrum (I_b). The sample spectrum is a ratio, usually reported as percent transmitted or reflected:

$$I = \frac{I_s}{I_b} \times 100$$

Two types of specular reflectance measurements are used, and they commonly called reflectance and absolute reflectance.

REFLECTANCE

The most common type of specular reflectance measurement is a relative measurement. The spectrum of the sample (I_s) is measured relative to a reference material (I_b). The resulting ratio, the reflectance or %R, has a spectral contribution not only from the sample but also from the reference material.

To minimize the spectral component of the reference material used for the background single beam spectrum, the reference materials chosen generally have high reflectivity in the wavelength range of interest and the reflectivity changes little as a function of wavelength. In the mid-infrared, Au and Al are the reference materials of choice. Note that the %R measured can exceed 100% if the reflectivity of the sample is greater than that of the reference.

Relative reflectance measurements are straightforward and easy to perform. They are used for both quantitative and qualitative work. Since the reflectance is a function of polarization, a polarizer is generally recommended for both the sample and background measurements except when working at near-normal incidence.

ABSOLUTE REFLECTANCE

For some applications, it is important to extract the reflectivity and/or the optical constants of the sample from the reflectance measurement. This type of information is primarily used for the development and inspection of optical coatings.

The absolute reflectance of a sample can be extracted from a relative reflectance measurement if the reflectance of the reference material is known at incident angle and polarization of interest. If the reflectance of the reference as a function of wavelength is $I_{b'}$, then the absolute reflectance of the sample, $I_{s'}$, can be calculated from the measured relative reflectance:

$$I_{s'} = I \times I_{b'}$$

Another approach is to measure the absolute reflectance directly. The most common method for this is to use a V-W accessory (see figure below). In the V mode, the light reflects only from the mirrors of the accessory. In the W mode, the light reflects from those mirrors and twice from the sample. No additional optics are introduced into the beam path between the sample and background measurements except the sample. The light reflects from the sample surface twice, the measured quantity is the square of the reflectance. The reflectance is simply extracted by taking the square root of the measured values.

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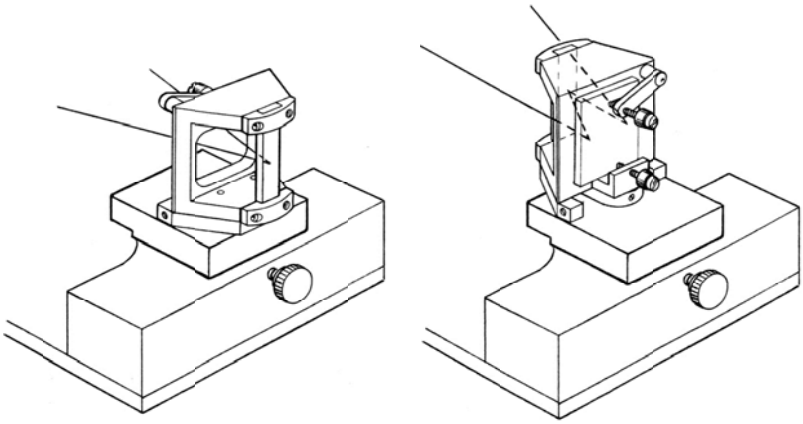

V-mode W-mode

The Harrick 12º Absolute Reflection Stage for the Variable Angle Reflection Accessory.

Because the V-W mirror assembly rotates, having the accessory and spectrometer well aligned is critical for accurate measurements. Use of a polarizer for both the sample and background measurements is also recommended except when working at near-normal incidence.