Measuring diffuse reflectance of solid samples with the Agilent Cary 60 UV-Vis

Application note

Materials

Authors

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Abstract

Measurements of solid materials are often difficult due to the size, shape and location of the samples. Large samples have to be broken for pieces to fit into an instrument sample compartment. However, many samples must stay intact and cannot be destroyed, such as when collecting reflectance and color data on a car at the end of the painting process. The ability to measure external to the instrument is preferable. Using the Agilent Cary 60 UV-Vis spectrophotometer and the remote fiber optic diffuse reflectance accessory addresses this need.

The Cary 60 has a reputation for outstanding performance when measuring liquid samples remotely via fiber optic probe accessories. Now the Cary 60 extends this performance to include fast and accurate solid sample reflectance measurements. The Agilent Cary 60 Remote Diffuse Reflectance Accessory (DRA) (Figure 1) benefits from the same unique Cary 60 technology, proven for testing liquids.

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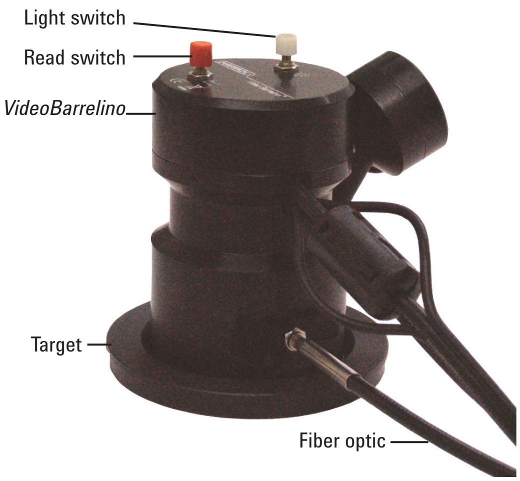


Figure 1. Cary 60 Remote DRA

The Cary 60's highly focused beam makes it ideal for fiber optic work, offering excellent coupling efficiency and high light throughput, which equates to better photometric performance. In addition, its room-light immunity enables sample measurements to be taken outside the sample compartment.

The Cary 60 Remote DRA design is optimized to use optical fiber up to 1.5 meters in length. The fiber channels light out of the instrument and focuses a 1.5 mm light patch onto the sample. The accessory has a 0/30° beam geometry, which allows diffuse reflectance to be measured by a detector mounted within the accessory. To assist accurate placement of the accessory on the sample, the Cary 60 Remote DRA includes a video camera that provides visual feedback on the computer screen. The display shows the exact point at which reflectance data will be collected.

Experimental

Materials

- Cary 60 UV-Vis spectrophotometer
- Cary 60 Remote DRA
- Cary 60 fiber optic coupler
- Cary WinUV software
- PTFE color samples

Method

Data was collected using the Cary 60 Remote DRA and the Cary WinUV Scan application. All color traces were baseline corrected and run over the range 360–830 nm. The 100% reflectance baseline was collected using a white PTFE sample.

Results

The spectra obtained from the four PTFE color samples are displayed in the graph below (Figure 2). The traces show typical profiles for PTFE color samples and all color spectra show very low noise.

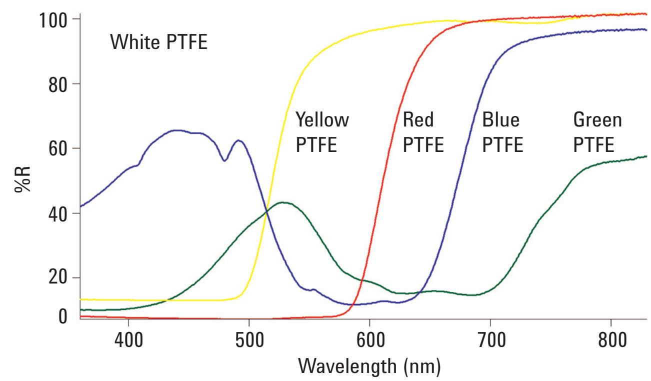


Figure 2. Diffuse reflectance spectra of four PTFE color samples

Reproducibility scans (Figure 3) were collected by running 10 repeated scans on one of the PTFE samples. The blue PTFE sample was selected because its spectra contain more structure than the other colors.

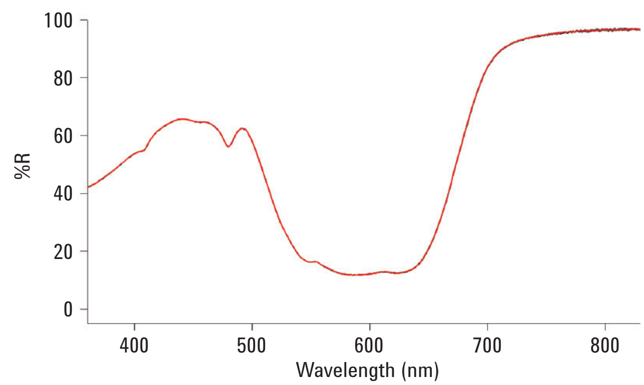


Figure 3. Diffuse reflectance spectra of 10 repeated scans of a blue PTFE sample

Zooming in on the structure between 460 nm and 500 nm (Figure 4), shows very reproducible traces. The average standard deviation between the 10 traces was 0.053 (%R). The highest was 0.213 (%R) and the lowest 0.007 (%R).

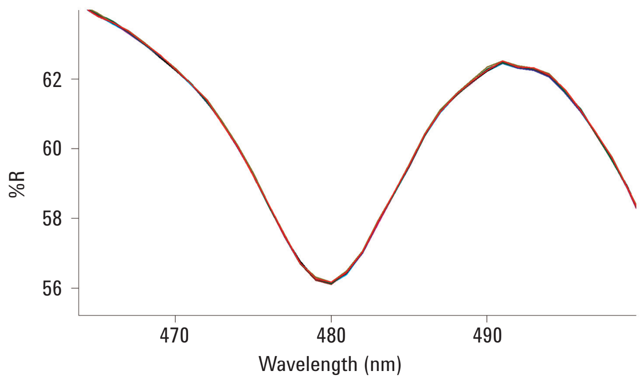
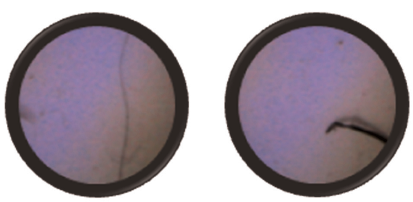


Figure 4. Diffuse reflectance spectra of 10 repeated scans of a blue PTFE sample from 460 nm to 500 nm

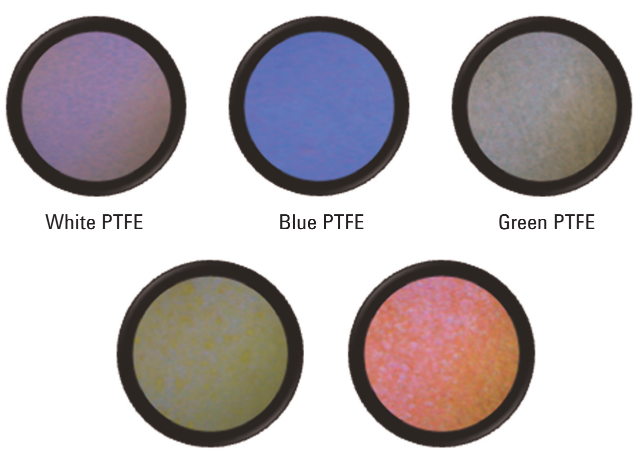
Video output

To ensure accurate placement of the Cary 60 Remote DRA onto the PTFE color samples, the integrated video camera was used. Any contaminants on or in the sample (Figure 5) could be easily seen on the computer monitor and avoided. Data was collected on the PTFE color samples, where the video field showed the samples were clean (Figure 6).



a. Hair   b. Plastic thread

Figure 5. Screen captures of the video output from the Cary 60 Remote DRA. White PTFE with contaminant (a) hair, (b) plastic thread



White PTFE   Blue PTFE   Green PTFE

Yellow PTFE   Red PTFE

Figure 6. Screen captures of the video output from the Cary 60 Remote DRA

Conclusion

The Cary 60 with Remote DRA is ideal for use when the sample must not be damaged, or where samples cannot be placed in the instrument sample compartment.

Examples include:

- Art restoration and conservation[1,2]
- Q/C in printing, paint and automotive industries

The integrated video camera allows for accurate placement on the sample for analysis.

The Cary 60 with Remote DRA presents a new solution for remote reflection measurements of solid samples, benefiting from the unique optical design of the Cary 60 that allows for superior light throughput, and photometric performance.

References

1. Marco Leona, Francesca Casadio, Mauro Bacci, & Marcello Picollo, "Identification Of The Pre-Columbian Pigment Maya Blue On Works Of Art By Noninvasive Uv-Vis And Raman Spectroscopic Techniques," *JAIC 2004, Volume 43, Number 1*, Article 4 (pp. 39 to 54)

2. Dan Drollette, "Spectrophotometer Finds Cure for Edo Blues," http://www.photonics.com/Article.aspx?AID=5620

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