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Application News

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Spectrophotometric Analysis

Measurement of Transmittance of Solar Battery Glass -Measurement of Transmittance of a Light Scattering Solid Sample-

Introduction

When measuring a solid sample with strong light scattering properties, using a 60 mm diameter integrating sphere can result in a change in photometric values at wavelengths where the detector is changed.
We have recently developed a 150 mm diameter integrating sphere. Using this integrating sphere increases the number of times light reflects inside the integrating sphere so when light reaches the detector it is more uniform, and also results in a more optimized detector arrangement, reducing the change in photometric values that occurs at detector switching wavelengths.
We introduce an example measurement of the transmittance of solar battery glass that is strongly light scattering, where the above described change in photometric values is prone to occur.

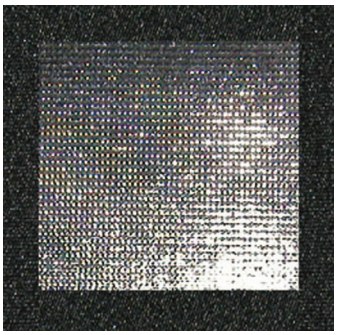

Fig. 1 Solar Battery Glass

Analysis of Solar Battery Glass

As shown in Fig. 1, solar battery glass has an uneven surface, and when light incidents on this surface it scatters unevenly.
When a sample of this type is analyzed, the incident light is reflected irregularly so there is a substantial difference in light behavior inside the integrating sphere between when a sample is measured and during baseline correction. This phenomenon sometimes gives rise to a change in photometric values at detector switching wavelengths.
We performed measurements of solar battery glass under the analytical conditions shown in Table 1, using the UV-3600 Plus and ISR-1503 (150 mm diameter integrating sphere with three detectors). Fig. 2 shows the UV-3600 Plus with ISR-1503 attached, and Fig. 3 shows the inside of the ISR-1503 on the left, and the sample installed on the right.

Fig. 2 UV-3600 Plus with ISR-1503 Attached

Table 1 Instrument and Analytical Conditions

Instrument used	: UV-3600 Plus UV-VIS-NIR spectrophotometer
Attachment	: ISR-1503 150 mm diameter integrating sphere (Internal wall: Barium sulfate)
Measurement wavelength range	: 250 to 2500 nm
Scanning speed	: Low speed
Sampling interval	: 1.0 nm
Photometric value	: Transmittance
Slit width	: (32)

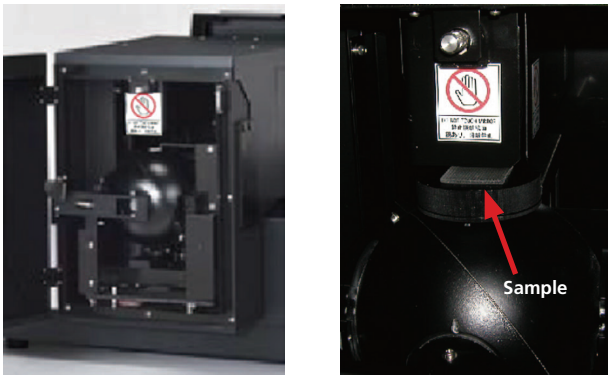

Fig. 3 Inside the ISR-1503 (left) and with Sample Installed (right)

Analytical Results

Fig. 4 shows the spectrum obtained using the ISR-1503 to measure the transmittance of solar battery glass.
When analyzing a strongly light scattering solid sample with a 60 mm diameter integrating sphere, a change in photometric values tends to occur around the detector switching wavelengths of 870 nm and 1650 nm. Fig. 4 shows that this change is hardly visible in the measured spectrum.

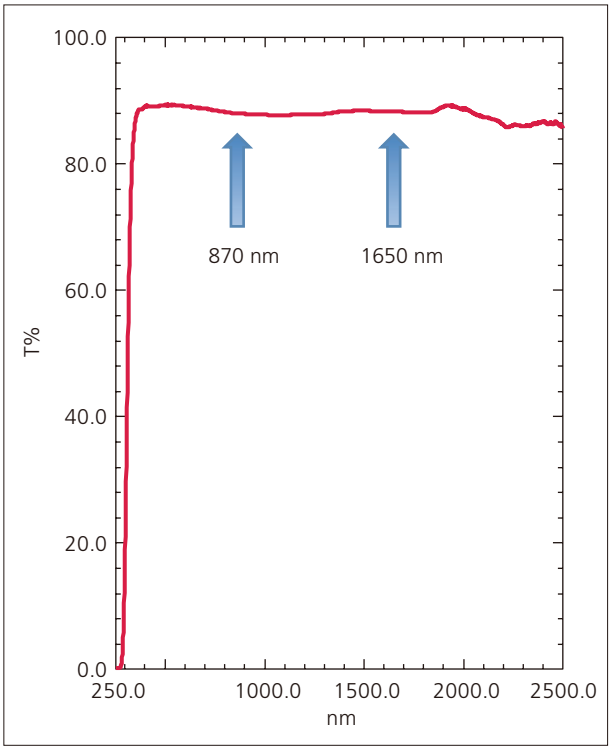

Fig. 4 Spectrum of Solar Battery Glass Measured with the ISR-1503

Advantages of the ISR-1503 Integrating Sphere

The advantages of the ISR-1503 are summarized in Table 2.
The ISR-1503 includes three detectors, PMT (photomultiplier tube), InGaAs, and PbS detectors. This allows for high sensitivity measurements across the all measured wavelengths (200 to 2500 nm).
Samples can also be installed horizontally when measuring transmittance. This feature makes the ISR-1503 convenient for analyzing samples that require extra caution if installed vertically, such as powders that tend to spill, films that need to be fixed in place with tape, conical samples that are difficult to fix in place, and heavy samples that are at risk of falling.
Furthermore, the ISR-1503 is designed with a small aperture ratio, which is the proportion of the internal surface area of the integrating sphere taken up by the inlet aperture. The aperture ratio used for reflectance measurements is 3.9 %, and for transmittance measurements is 2.8 %. The ISR-1503 is compatible with the low aperture ratios prescribed in official analytical methods*1).
While a barium sulfate internal wall integrating sphere was used in this analysis, a Spectralon® fluorine-based resin*2) internal wall integrating sphere is also available. A Spectralon® specification integrating sphere results in no hydroxyl radical absorption around 1450 nm and 1950 nm, maintaining high reflectance across a wide wavelength range and so allowing for low-noise measurements.

Table 2 Advantages of the ISR-1503

(1)	High-sensitivity measurements with three detectors (PTM, InGaAs and PbS) PTM : 200 to 870 nm InGaAs : 870 to 1650 nm PbS : 1650 to 2500 nm
(2)	Samples can be placed horizontally.
(3)	Compatible with measurements that require low aperture ratios.

Conclusion

Using the UV-3600 Plus and ISR-1503 allowed for the collection of spectra with almost no change in photometric values at detector switching wavelengths, even when analyzing strongly light scattering solar battery glass.

*1) ISO 13468-2: 1999, DIN 14500: 2008, ASTM D 1003-92, ASTM E9003-96, JIS K5600-4-4, JIS K7136, JIS K7361-1, JIS K7375, JIS Z8722
*2) Spectralon® is a registered trademark of Labsphere, Inc.

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