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Application News

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Spectrophotometric Analysis

Measurement Examples of Glass in Various Shapes

Around us there are a multitude of parts which are processed into various shapes to best fit their intended applications. As such, the need is increasing to be able to appropriately hold cylindrical samples and thin samples to achieve accurate measurements.

This article introduces examples of utilizing two sample holders which can meet the above needs: a cylindrical sample holder and a glass/film holder for the standard sample compartment.

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Evaluating Circular Glass

Fig. 1 shows the cylindrical sample holder. There are three types to the cylindrical sample holder, each capable of holding a sample size of ϕ5 to 25 mm (D25 mm), ϕ30 to 50 mm (D50 mm), and ϕ40 to 110 mm (D110 mm) respectively. By holding a sample at its periphery with springs, this holder is capable of holding a sample so that the incident beam strikes the center of the sample.

Four pieces of ϕ20-mm fused quartz with differing thicknesses were prepared for measurement. A D25 mm cylindrical sample holder and a light beam diagram unit were set on a spectrophotometer and the samples were measured using the conditions listed in Table 1. Fig. 2 shows the obtained transmittance spectra which indicate absorption at 1387 nm. Table 2 and Fig. 3 indicate the relationship between the sample thickness and the absorbance at 1387 nm. We can see from Fig. 3 that absorbance is proportional to the sample thickness.

Fig. 1 Cylindrical Sample Holders for D25 mm, D50 mm, and D110 mm Respectively (in order from front to back)

Table 1 Measurement Conditions

Instrument Used	: UV-3600 Plus, MPC-603A, Cylindrical sample holder (D25 mm), Light beam diaphragm unit
Wavelength Range	: 1000 nm to 1600 nm (fused quartz sample)
Scan Speed	: Low speed
Sampling Interval	: 1.0 nm
Slit Width	: (12) nm

Table 2 Relationship between Sample Thickness and Absorbance (Transmittance) at 1387 nm

Thickness	Absorbance (Abs)	Transmittance (%T)
1 mm	0.03	93.97
3 mm	0.04	91.36
5 mm	0.05	88.92

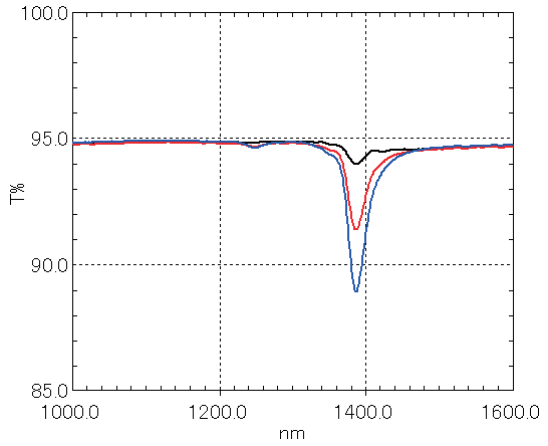

Fig. 2 Transmittance Spectra
Black: 1 mm, Red: 3 mm, Blue: 5 mm

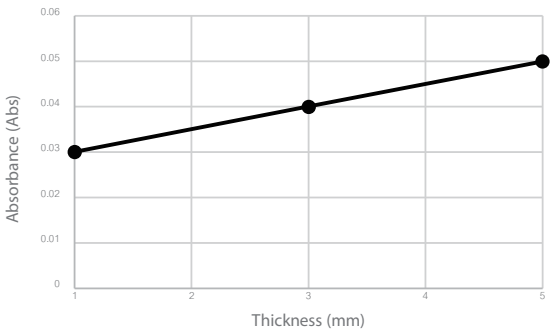

Fig. 3 Relationship between Sample Thickness and Absorbance at 1387 nm

Measurement Repeatability of a 15-mm Square Glass Sample

Fig. 4 shows the glass/film holder for the standard sample compartment. The holder is equipped with a grooved unit[*1] which enables precise holding of samples that are 15×15 mm (thickness: 1 mm) in size. Two types of 15-mm square glass plates (material: BK7 and quartz) were measured five times each by repositioning the sample for each measurement. Table 3 lists the measurement conditions and Figs. 5 and 6 show the measurement results.

Table 3 Measurement Conditions

Instrument Used	: UV-3600 Plus, Glass/film holder for standard sample compartment
Wavelength Range	: 300 nm to 800 nm (15-mm square sample) 500 nm to 1800 nm (anti-reflective coating sample)
Scan Speed	: Low speed
Sampling Interval	: 1.0 nm
Slit Width	: 2.0 nm (15-mm square sample) 5.0 nm (anti-reflective coating sample)
Detector Switching Wavelength	: 850/1650 nm
Grating Switching Wavelength	: 780 nm

Fig. 4 Glass/Film Holder for Standard Sample Compartment

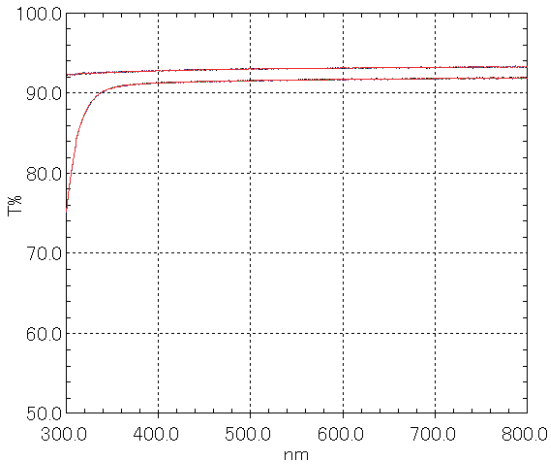

Fig. 5 Transmittance Spectra from Measurement by Repositioning Samples
Top: Quartz, Bottom: BK7
Black: 1st, Red: 2nd, Blue: 3rd, Green: 4th, Purple: 5th

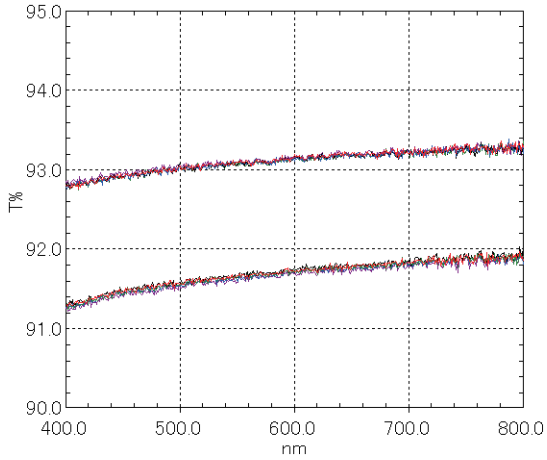

Fig. 6 Enlarged View of Fig. 5

Fig. 5 shows that when the glass material is BK7, transmittance is low in the ultraviolet range where wavelengths are shorter than 350 nm. When the glass material is quartz, transmittance is high at above 90 %T even in the ultraviolet range. Since both samples are set using the glass/film holder for the standard sample compartment, the repeatability of the spectra is favorable as shown in Fig. 6. Table 4 lists the photometric values obtained at 500 nm through the above measurements and the photometric values obtained at 500 nm by measuring the spectrum repeatedly without repositioning the sample. Both the average value and standard deviation are of the same level when the sample was repositioned and not repositioned.

Table 4 Repeatability of Transmittance at 500 nm

	BK7		Quartz	
	Repeat	Reposition	Repeat	Reposition
1st	91.499	91.563	93.053	93.026
2nd	91.503	91.550	93.072	93.041
3rd	91.519	91.531	93.085	93.028
4th	91.511	91.535	93.050	93.044
5th	91.511	91.510	93.077	93.049
Ave.	91.509	91.538	93.067	93.038
SD.	0.007	0.018	0.014	0.009

The glass/film holder for the standard sample compartment can also be used as an ordinary film holder. Fig. 7 shows the spectra obtained from a glass that is applied an anti-reflective coating (commercially available) using the conditions listed in Table 3. Anti-reflection is achieved by a dielectric multilayer film at 650 to 1050 nm and 750 to 1550 nm, and the transmittance in those ranges is near 100 %.

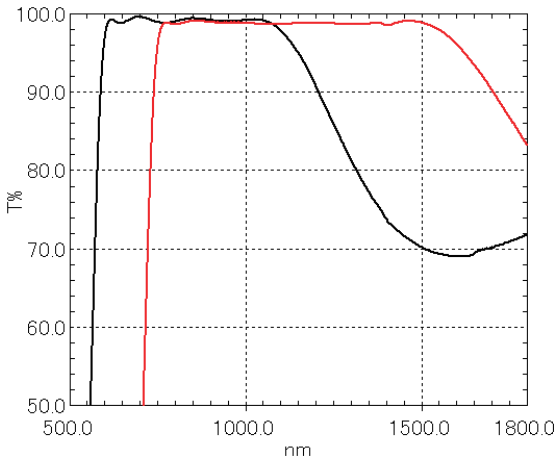

Fig. 7 Transmittance Spectra of Glass Sample with Anti-reflective Coating
Coating Wavelength Range
Black: 650 nm to 1050 nm, Red: 750 nm to 1550 nm

Conclusion

Measurement of a circular glass sample was done easily using the cylindrical sample holder which allowed to hold the sample centered with respect to the light beam. Also, the glass/film holder for the standard sample compartment enabled precise holding of a 15-mm square sample and data with favorable repeatability was obtained. Samples of various shapes and thickness can be held appropriately and measured with good precision by using accessories suitable for each specific sample.

*1 The size of the groove can be changed according to the size of the sample.

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