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UV-Vis Spectrophotometer UV-2600i Plus

Application News

Using the UV-2600i Plus and ISR-2600Plus to Perform UV-Vis-NIR Measurements on Various Types of Glass

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User Benefits

- Combining the UV-2600i Plus and ISR-2600Plus enables measurements to be performed at ultraviolet, visible, and near-infrared wavelengths up to 1,400 nm.
- Using an integrating sphere allows measurements of both transmittance and reflectance.
- The spectral evaluation features can be used to calculate average values for spectral measurements in user-defined wavelength regions.

■ Introduction

Since crude oil and natural gas are finite energy sources, there have been numerous innovations to reduce energy consumption. One such innovation is heat mirror glass, which reduces heat by blocking near-infrared (NIR) thermal radiation while allowing in visible light so that rooms are illuminated by external light, reducing energy consumption from artificial lighting. Glass that blocks ultraviolet light is also desirable since it prevents skin damage associated with exposure to ultraviolet (UV) light.

This Application News analyzes different types of glass and uses the averaging functionality, which is included as standard with the evaluation features of LabSolutions™ UV-Vis to determine the mean transmittance and reflectance of glass samples in UV, visible, and NIR wavelength regions.

Fig. 1 UV-2600i Plus System

■ Measuring the Transmittance of Glass

Measurements were performed using the UV-2600i Plus system shown in Fig. 1. Combining the UV-2600i Plus with the ISR-2600Plus integrating sphere attachment enables measurements across a wide range of wavelengths from 220 to 1,400 nm. Three glass samples were analyzed: one transparent glass and two treated glasses (glass A and glass B). Fig. 2 shows the glass samples that were analyzed.

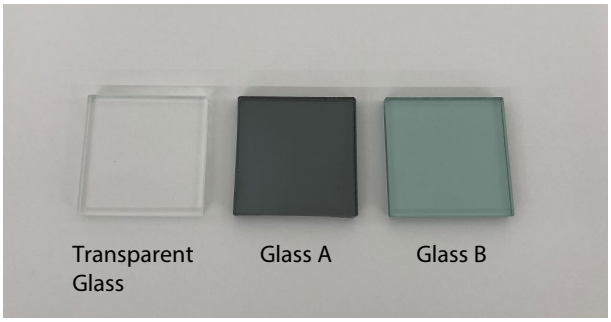


Fig. 2 Glass Samples Used in Analysis

Glass transmittance was measured under the conditions shown in Table 1 and the resulting transmittance spectra are shown in Fig. 3. Fig. 3 shows that near-infrared light above 780 nm passed through the transparent glass extremely well. However, glasses A and B exhibited poor transmission characteristics at these wavelengths, and they transmitted less than 50 % of near-infrared light above 780 nm. The transparent glass and glass B also exhibited good transmittance in the visible wavelength range of 380 to 780 nm, but visible light transmission was not as high through glass A. Therefore, glass B seems to be the most effective of the three samples at preventing rises in room temperature from solar radiation.

Furthermore, at ultraviolet wavelengths below 380 nm, the transparent glass exhibited high transmittance whereas glasses A and B exhibited low transmittance. So, glasses A and B should be more effective at reducing ultraviolet light exposure and the associated skin damage.

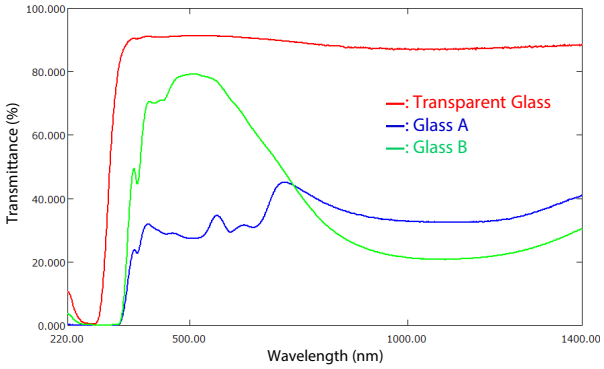


Fig. 3 Transmittance Spectra of Glass Samples

Table 1 Measurement Conditions

Equipment:	UV-2600i Plus ISR-2600Plus
Software:	LabSolutions UV-Vis
Measured Wavelength Range:	220 to 1,400 nm
Scanning Speed:	Medium
Sampling Interval:	1.0 nm
Split Width:	5.0 nm

■ Measuring the Relative Reflectance of Glass

This section describes measuring the relative reflectance of the glass samples. A barium sulfate white standard board was used as the reflectance standard, and measurements were performed under the same conditions (Table 1). The reflectance spectra that were recorded are shown in Fig. 4. The transparent glass and glass B exhibited low relative reflectance of around 10 % across all wavelengths (UV, Vis, and IR), whereas the relative reflectance of glass A was low at the longest IR wavelengths, but gradually increased toward visible wavelengths. In practical terms, a high relative reflectance in the visible light region reduces the amount of external light entering a room, hence the interior of a room with glass A should be difficult to view from outside.

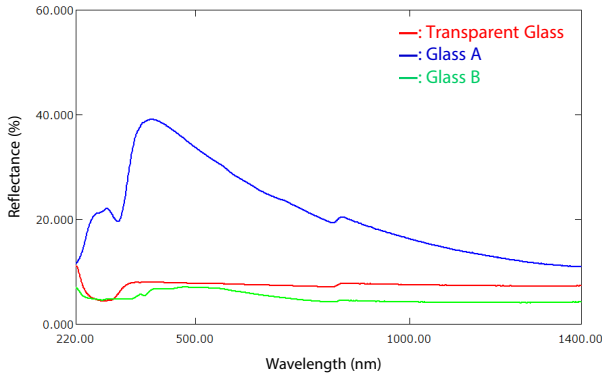


Fig. 4 Relative Reflectance Spectra of Glass Samples

■ Average Values in Each Wavelength Region

Glass properties are often evaluated by comparing spectra and determining transmittance and reflectance behavior at various wavelengths. The ability to calculate average values for spectral parameters, such as reflectance and transmittance in specific wavelength regions, provides a convenient statistical value that describes glass properties in an easy-to-understand manner.

The spectral evaluation features in LabSolutions UV-Vis include an averaging functionality that can quickly calculate the average values of spectral parameters in UV, visible, and IR wavelength regions. The user specifies the wavelength range, and the averaging feature calculates the mean transmittance, reflectance, absorbance, etc. in that range. Fig. 5 shows the advanced settings window for this feature.

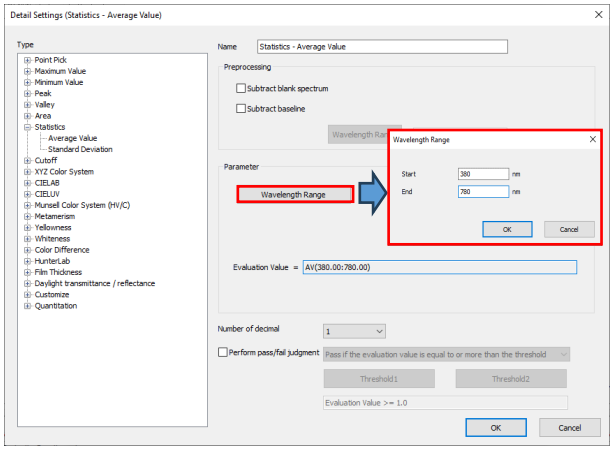
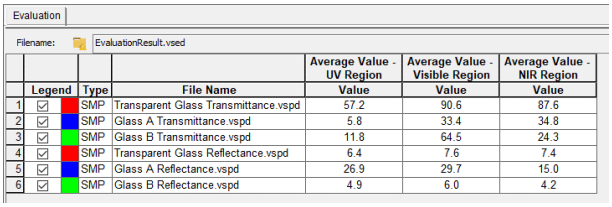


Fig. 5 Settings Window for Calculating Average Values

In the advanced settings window for this feature, the user can display the [Detail Settings] window (Fig. 5) by clicking [Table Settings] in the evaluation table and selecting the [Add] button in the [Items] tab. Next, the user selects [Statistics]-[Average Value] and clicks the [Wavelength Range] button displayed under [Parameter] to set the wavelength range that will be used to calculate the average values. Note that multiple average values cannot be configured under a single name. They must be configured under different names.

In this case, 280 to 380 nm (UV), 380 to 780 nm (visible), and 780 to 1,400 nm (NIR) were configured and used to calculate average values. The resulting statistical data are shown in Fig. 6.


Evaluation

Filename: EvaluationResult.vsed

	Legend	Type	File Name	Average Value - UV Region Value	Average Value - Visible Region Value	Average Value - NIR Region Value
1	☑	SMP	Transparent Glass Transmittance.vspd	57.2	90.6	87.6
2	☑	SMP	Glass A Transmittance.vspd	5.8	33.4	34.8
3	☑	SMP	Glass B Transmittance.vspd	11.8	64.5	24.3
4	☑	SMP	Transparent Glass Reflectance.vspd	6.4	7.6	7.4
5	☑	SMP	Glass A Reflectance.vspd	26.9	29.7	15.0
6	☑	SMP	Glass B Reflectance.vspd	4.9	6.0	4.2

Fig. 6 Calculated Average Values

Calculating average values provides a convenient quantitative measure of glass properties in each wavelength region.

Note that spectrum data files can be added to the evaluation table by dragging and dropping the files from the tree view on the left side of the software window.

■ Automating Evaluation

The [Others] tab in [Table Settings] includes an option to automatically add spectrum data files to the evaluation table. Fig. 7 shows the table settings window for automating evaluation. If the upper check box in Fig. 7 is selected, spectrum data files are automatically added to the evaluation table after measurement. If the lower check box in Fig. 7 is selected, opening a spectrum data file automatically adds it to the evaluation table. These settings allow spectrum data files to be added to the evaluation table automatically without using the drag-and-drop feature.

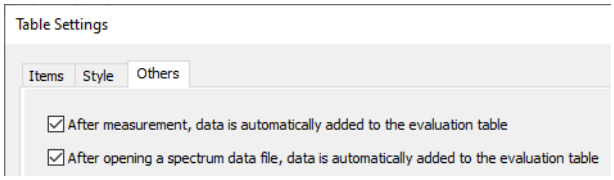


Fig. 7 Settings Window for Automating Evaluation

■ Conclusion

Shimadzu's UV-2600i Plus UV-Vis spectrophotometer and ISR-2600Plus integrating sphere attachment were used to measure the transmittance and reflectance of glass samples across a wide range of wavelengths from UV to NIR. The spectral evaluation features included as standard in the LabSolutions UV-Vis software were also used to calculate the average values for these measurements in specific wavelength regions and thereby evaluate the properties of the glass samples.

In addition, if the table setting for automation ("After measurement, data is automatically added to the evaluation table") is selected (Fig. 7), the results automatically appear in the evaluation table as soon as the spectral measurement is complete.

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