SHIMADZU

Application News

No.A440

Spectrophotometric Analysis

Introduction of Shimadzu UV-2700 UV-Visible Spectrophotometer for High Absorbance Measurement

The UV-2700, with its low stray light diffraction grating, is a spectrophotometer that offers an extremely wide photometric range. Traditionally difficult-to-measure high-absorption samples can now be easily measured. It is the ideal instrument for measuring samples which cannot be thinly sliced, diluted or subjected to other pretreatment procedures. Here, we introduce examples of measurement of high-absorption samples using the UV-2700.

Overview of Instrument

The UV-2700 is equipped with Shimadzu's proprietary Lo-Ray-Ligh® low-stray-light diffraction grating to achieve an ultra-low level of stray light. Fig. 1 shows the Lo-Ray-Ligh® low-stray light diffraction grating. This diffraction grating extends the photometric range to an absorbance of 8 (transmittance 0.000001 %), not possible with existing instruments, thus offering measurement precision at a whole new level of magnitude.
Moreover, the instrument features a space-saving design of 450 mm width × 600 mm depth × 250 mm height, packing high performance into an extremely compact instrument. Fig. 2 shows a photograph of the instrument.

Fig. 1 Lo-Ray-Ligh® Diffraction Grating

Fig. 2 UV-2700 UV-Visible Spectrophotometer

Measurement of Potassium Permanganate Aqueous Solution

We prepared 8 potassium permanganate ($KMnO_4$) aqueous solutions at different concentrations (65 mg/L – 520 mg/L) with peak absorbances of approximately 1 – 8, and conducted measurements to check the spectra in the high absorbance region, and the calibration curve linearity. The spectra are shown in Fig. 3, and the measurement conditions are shown in Table 1. Excellent spectra with little noise evident in the extremely high absorbance region were obtained.
The calibration curve generated from the peak absorbances in the vicinity of 525 nm of the obtained spectra is shown in Fig. 4. The calibration curve clearly shows excellent linearity all the way up to the high absorbance region.

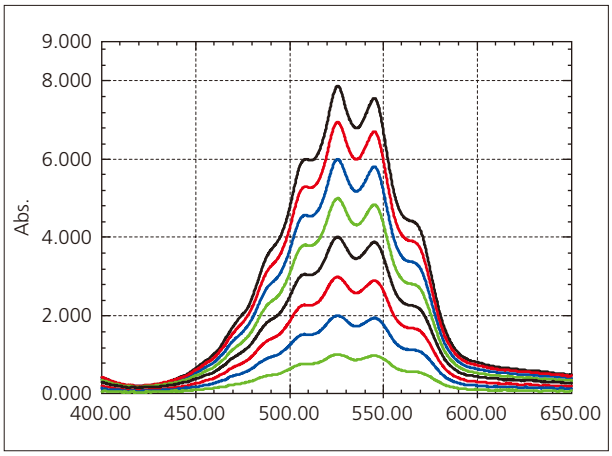

Fig. 3 Absorption Spectra of Potassium Permanganate Aqueous Solutions

Table 1 Measurement Parameters

Instrument	: UV-2700
Measurement wavelength range	: 400 nm – 650 nm
Scan speed	: High absorbance (medium speed)
Sampling pitch	: 0.1 nm
Measurement value	: Absorbance
Slit width	: 5.0 nm

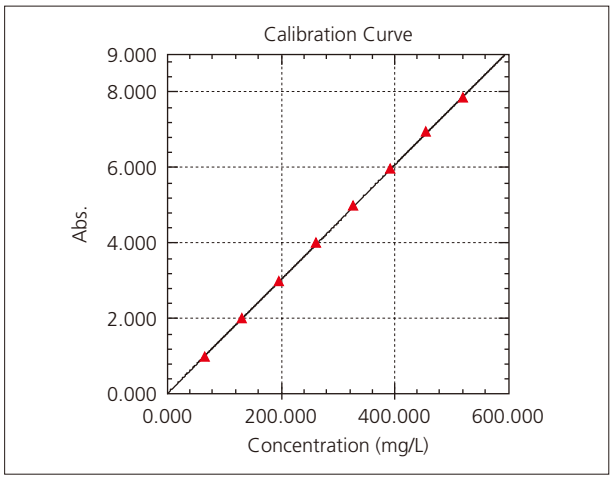

Fig. 4 Calibration Curve of Potassium Permanganate Aqueous Solutions

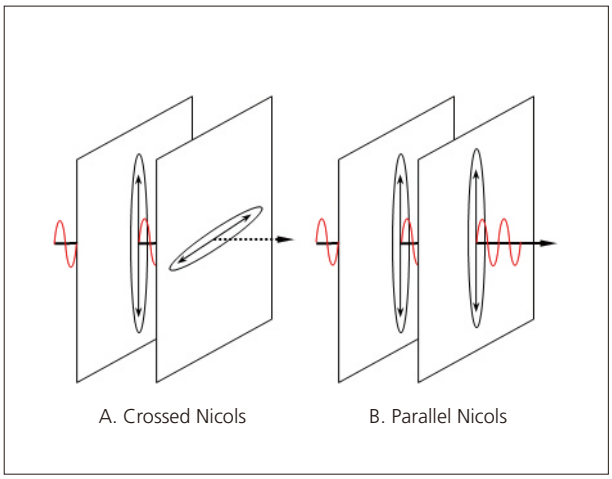

Fig. 6 Placement of Films

Measurement of Polarized Film

Polarized film is a material that is widely used in liquid crystal displays and sunglasses, etc. Natural sunlight transmits light waves whose electric field vibrates in various directions, but this film consists of a material that allows only light vibrating in single plane to pass through, and is evaluated on the basis of screening and transmittance characteristics.

Fig. 5 shows a rotating film holder which is used for measurement of polarized films. Two polarized film samples are set in the film holder, and one of the films is rotated in the plane. First, as shown in Fig. 6A, measurement is conducted with the film transmission axial directions at right angles to each other (crossed Nicols) to achieve the greatest level of screening. At this time, the transmittance shows its lowest value. Next, one of the polarized films is rotated 90 degrees, so that the transmission axial directions are parallel (parallel Nicols) to achieve the greatest light transmission, and measurement is conducted.

Fig. 7 shows the polarized film measurement results. Measurement was conducted using the parameters shown in Table 2. Even in the region of extremely high screening, in the range of 5-absorbance (0.001 % transmittance) in the crossed Nicols condition, a good spectrum is obtained.

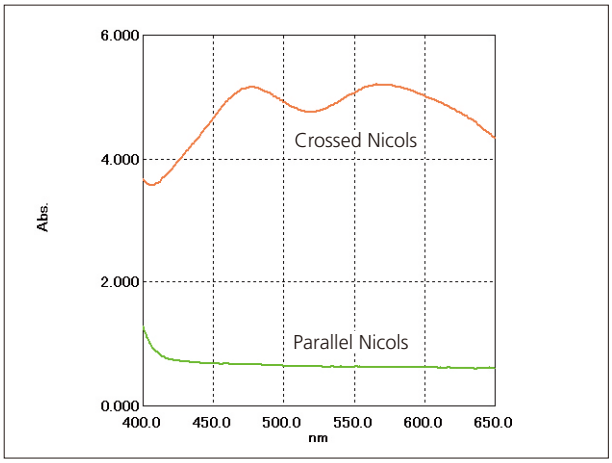

Fig. 7 Results of Polarized Film Measurements

Table 2 Measurement Parameters

Instrument	: UV-2700
Measurement wavelength range	: 400 nm – 650 nm
Scan speed	: High absorbance (medium speed)
Sampling pitch	: 0.1 nm
Measurement value	: Absorbance
Slit width	: 5.0 nm

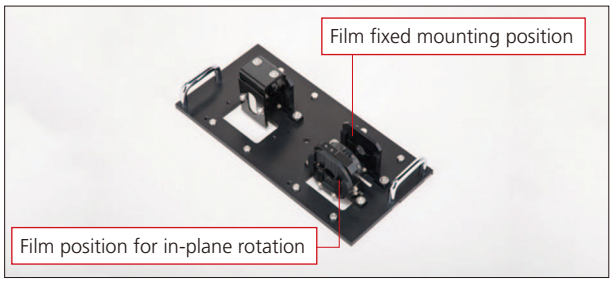

Fig. 5 Rotating Film Holder

Conclusion

Using the UV-2700 with its ultra-low level stray light, it is now possible to conduct measurement of samples that display extremely high absorption. Thus, it is the best instrument for high absorbance samples which cannot be thinly sliced, diluted or subjected to other pretreatment procedures, such as the polarized film used in this analysis.

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