New Solutions for Solid Sample Measurement! The Introduction of SolidSpec-3700/3700DUV The World First 3-Detector System realizes The High Sensitivity Measurements in Entire NIR Region

The new SolidSpec-3700/3700DUV UV-Vis-NIR Spectrophotometer has been placed on the market to demonstrate its power in the fields of optics and semiconductors.
The SolidSpec-3700 is the standard model, while the SolidSpec-3700DUV is specified for analysis in the deep UV (DUV) region. These new products, equipped with various features, including the extra large sample compartment provided as standard and support a wide range of applications.
The SolidSpec-3700/3700DUV incorporates three detectors – photomultiplier tube, cooled PbS detector and InGaAs detector. The InGaAs and cooled PbS detectors are used for the NIR (near infrared) region to achieve high sensitivity over the entire NIR region. In addition, the SolidSpec-3700DUV allows measurement in the DUV region (165 – 190nm)that was difficult with conventional spectrophotometers, enabling evaluation of semiconductor parts in the DUV region, which is necessary in the semiconductor field. Introduced here are examples of reflectance and transmittance measurements with particular focus on the sensitivity improvement due to the three-detector system.

■ Advantage of Three Detectors

Previous UV-Vis-NIR spectrophotometers used only two detectors, a photomultiplier tube and a PbS detector. Because these detectors have low sensitivity in the vicinity of 900nm, sufficient sensitivity was not achieved in this region. The SolidSpec-3700 raises the sensitivity in this region by adding an InGaAs detector for the intermediate region (refer to Fig.2).
Fig.3 shows the diffuse reflectance spectrum of plant leaf (Benjamina), and Fig.4 shows the transmittance spectrum of a band-pass filter. The measurement was conducted in the range of 600 to 1200nm using an integrating sphere. A Good spectra were obtained. By using the SolidSpec-3700DUV, data with minimum noise can be obtained in this region, where sufficient sensitivity could not be achieved with conventional analyzers.

Fig.1 SolidSpec-3700/3700DUV

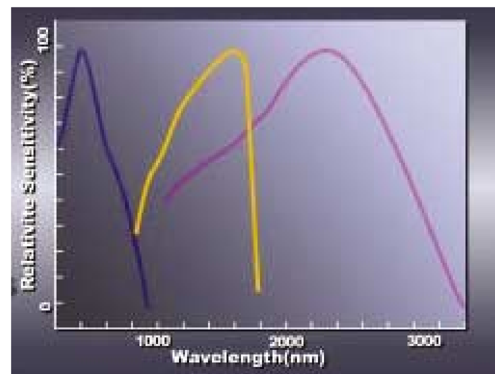

Fig.2 Characteristics of Three Detectors (Blue: photomultiplier tube; red: PbS detector; Yellow: InGaAs detector)

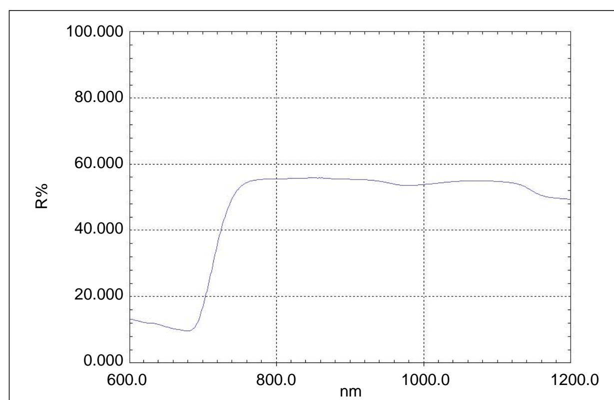

Fig.3 Diffuse Reflectance Spectrum of Plant Leaf

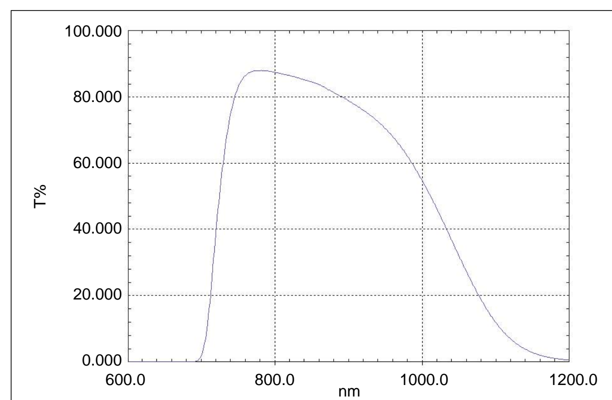

Fig.4 Transmittance Spectrum of Band-pass Filter

■ Absolute Specular Reflectance Measurement

By mounting an optional absolute reflectance measurement accessory in the SolidSpec-3700/3700DUV, the absolute reflectance of an object can be measured. Fig.5 shows an absolute reflectance measurement (5˚ incidence angle) spectrum using a Molybdenum coated mirror, and Fig.6 shows a enlarged view of the 700 – 1200nm range. An excellent spectrum is obtained showing little noise over the entire measurement wavelength range.

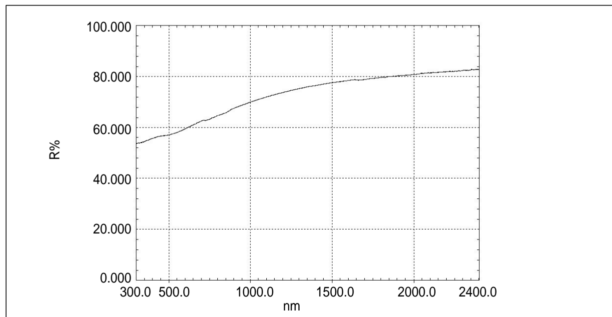

Fig.5 Absolute Specular Reflectance (5˚ incidence angle) Spectrum of Mo-coated Mirror

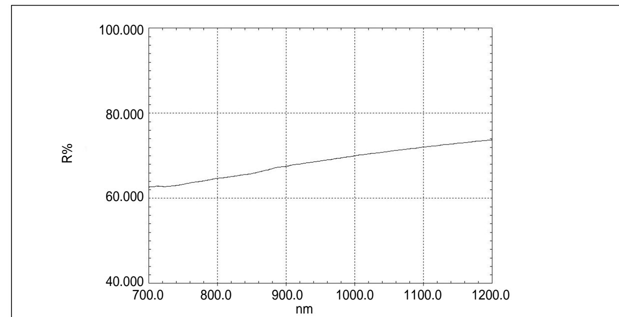

Fig.6 Enlarged View of Fig.5

■ Measurement in DUV Region (with the integrating sphere)

By purging with nitrogen, it becomes possible to conduct DUV region measurement. Here, by purging with nitrogen and mounting an integrating sphere, transmittance measurement of a mask blank, a semiconductor lithography-related part, was conducted in the measurement range of 175 – 400nm. Fig.7 and Fig.8 show the results with and without the nitrogen purge, respectively. By purging with nitrogen, an excellent spectrum can be obtained in the DUV range. The shortest limit of the measurement wavelength is 175nm when using the integrating sphere.

Note: The purging with nitrogen requires a flowrate of 80 – 100L/min (with integrating sphere).

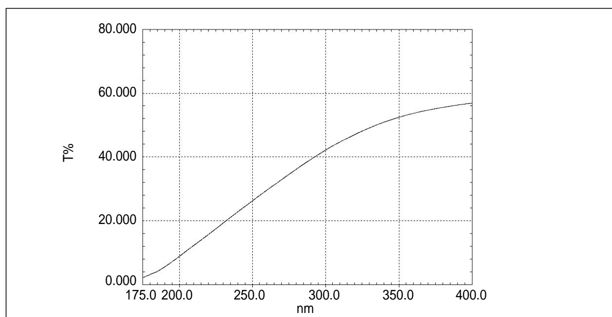

Fig.7 Transmittance Spectrum of Mask Blank (with N_2 purge)

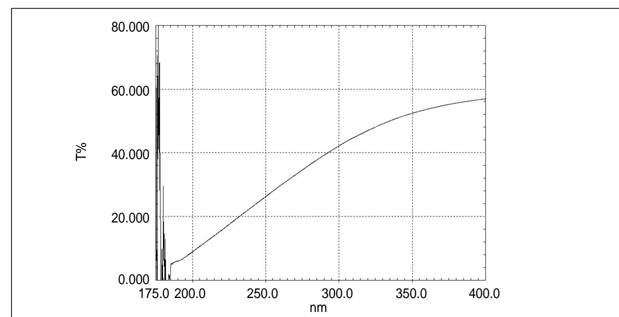

Fig.8 Transmittance Spectrum of Mask Blank (without N_2 purge)

■ Measurement using Direct Detection Unit (an optional accessory)

Using the direct detection unit, the sensitivity can be improved beyond that with the standard integrating sphere. In the semiconductor lithography-related field, measurement at 193.4nm is important. If the direct detection unit is used, extremely accurate measurement is possible at this wavelength even without a nitrogen purge. Fig.9 shows a transmittance spectrum of a mask blank using the direct detection unit, and Table 1 shows the results of ten measurements repeated at 193.4nm (comparison with use of integrating sphere). Fig.9 clearly shows that excellent spectra can be obtained up to the vicinity of 190nm without a nitrogen purge. Table 1 also shows that good reproducibility is obtained.

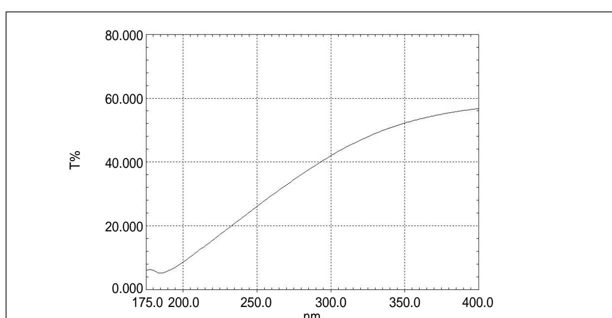

Fig.9 Transmittance Spectrum of Mask Blank (without N_2 purge)

Table 1 Transmittance Measurement Repeated at 193.4nm (without nitrogen purge)

No. of Repetitions	Integrating Sphere without N_2 Purge	Direct Detection Unit without N_2 Purge
1	6.727	6.727
2	6.707	6.726
3	6.763	6.725
4	6.734	6.724
5	6.716	6.722
6	6.580	6.718
7	6.667	6.724
8	6.646	6.722
9	6.743	6.720
10	6.761	6.721
Average	6.7044	6.7229
Standard Deviation	0.0547	0.0027

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