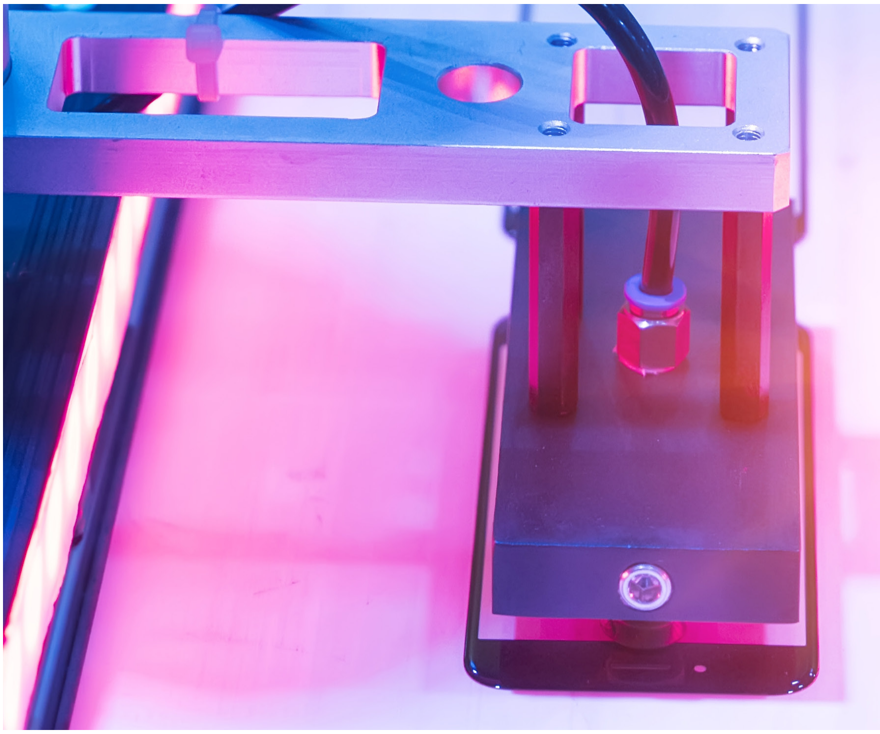
APPLICATION NOTE

UV/Vis/NIR Spectroscopy



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Transmittance Test for Infrared Proximity Sensors in Mobile Phones

Introduction

Biosensors are devices that are sensitive to biomolecules and convert biological responses into electrical signals for detection. Good selectivity, high sensitivity, fast analysis speed have contributed to their rapid expansion into the smart phone industry. The dramatic rise in global adoption and use of smart phones in our day-to-day lives has brought with it advances such as face, speech, and fingerprint recognition. These features enable a user to control the device by sensing and recognizing changes in their body and facial expressions. Although smart phone usage has increased dramatically, many users are unaware of the proximity sensors used in their devices. The proximity sensor (infrared hole) is one of many possible biosensors and is usually identifiable as a black round hole located at the top of the mobile phone screen. These biosensors control mobile phone screens by sensing infrared changes occurring in the human body, making them more useful to consumers.

The proximity sensor uses infrared (IR) waves emitted from the biological source to sense distance. When answering a call, the screen automatically blacks out when held close to the ear to avoid unintentional dialing or launching of an application. When moved away from the ear, the screen automatically lights up again for normal operation. This functionality is achieved through the detection of infrared rays emitted by the human body. To achieve such screen control, the IR hole on the mobile phone has to selectively pass infrared rays, while blocking ultraviolet rays and visible light.

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Global Transmittance Specifications

During mobile phone production process, the transmittance of IR holes is tested at different wavelengths to ensure quality control. Several test points at different wavelengths are generally selected, including 550 nm (visible light), 850 nm (infrared) and 950 nm (infrared). European and American standards require testing transmittance at 550 nm and 850 nm, while Japanese and Korean standards generally use transmittance at 550 nm and 940 nm. Quality control specifications require the transmittance of mobile phone IR hole be more than 80% at 850 nm, and less than 15% at 550 nm. This enables the IR hole to accurately sense the changes in infrared rays while avoiding interference from visible light.

Accurate Results with an Integrating Sphere

The samples to be tested are generally in the form of a small hole on a sheet. When test samples are analyzed in reflection mode, there is a large diffuse reflection signal in addition to a specular reflection signal. When test sample are analyzed in transmission mode, there are a large number of scattered signals in addition to the vertical transmission signal. If a standard detector is used, only a part of the light can be collected. The scattered signal cannot be detected resulting in an inaccurate test. An integrating sphere detector can be used to collect all spectral signals from reflected or transmitted samples (Figure 1), improving the accuracy of results.

PerkinElmer LAMBDA 1050+ UV/Vis/NIR Spectrophotometer with Integrating Sphere

When conducting analyses on a test sample with the 150 mm integrating sphere detector, the inner wall coating and integrating sphere size have a direct effect on the test results. Common inner sphere coatings include Magnesium oxide, Barium sulfate and Teflon coatings. Among these, magnesium oxide and barium sulfate coatings have low reflectivity and poor long-term stability, resulting in the problem of yellowing after long-term use. Figure 2 shows how magnesium oxide and barium sulfate coatings have low reflectance above 1600 nm and are not suitable for the near-infrared band test. PerkinElmer's 150 mm integrating sphere detector uses a Teflon coating for high light reflectivity with full-band reflectance that does not fluctuate much, improving the long-term stability. In addition, the integrating sphere has a large aperture for a smaller incident light window/internal surface area ratio, resulting in a smaller aperture ratio for minimal light loss and better results. PerkinElmer's 150 mm Teflon coated integrating sphere achieves high reflectivity and more accurate test results.

The PerkinElmer LAMBDA 1050+ dual-beam UV/Vis/NIR spectrophotometer uses a 150 mm Teflon-coated integrating sphere detector with high reflectivity, long-term stability, and no yellowing denaturation. The integrating sphere also has a small opening ratio resulting in minimal light loss and more accurate test results. The instrument has a dual beam and double monochromator design, enabling ultra-low stray light (stray light only 0.00007% T), high wavelength accuracy, precision, maximum test absorbance of 8A resulting in more accurate results.

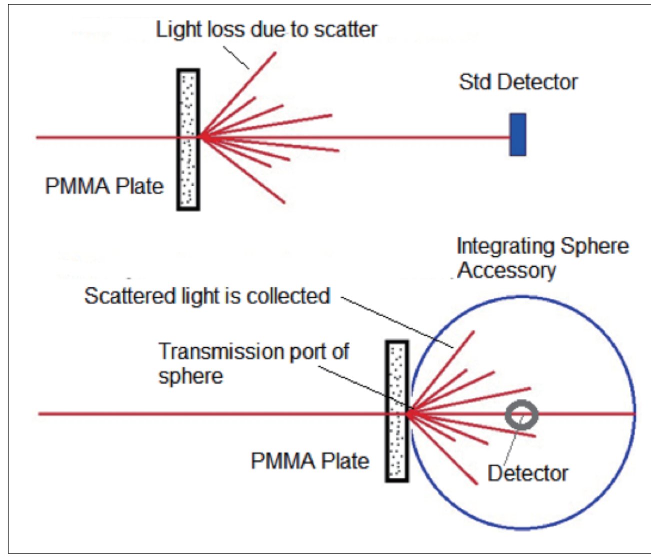

Figure 1. Light path through a standard detector (top) and integrating sphere detector (bottom).

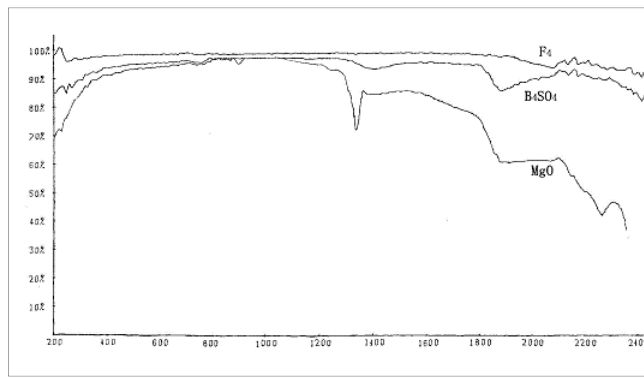

Figure 2. Spectral diagram showing the effects of different coatings inside the integrating sphere.

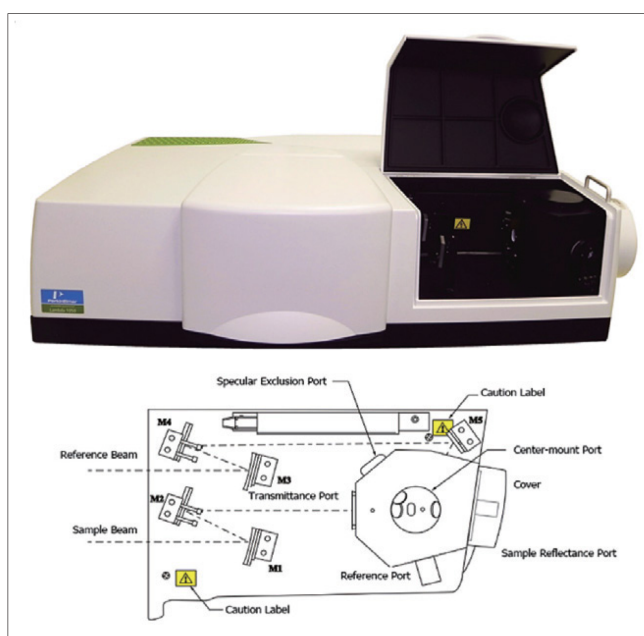

Figure 3. PerkinElmer LAMBDA 1050+ UV/Vis/NIR spectrophotometer with integrating sphere (top) and light path (below).

Sample Test

Test Conditions

Test wavelength: 1000-400 nm; wavelength interval 5 nm, integration time 0.3 sec, test transmittance T%.

Test Process

During the test, no pre-treatment is required. After sweeping the air background, the sample is fixed at the entrance of the instrument, and the transmission curve of the sample at 400-1000 nm is obtained for transmittance values of the sample at different wavelengths. The spectrum is shown in Figure 5. The same sample was tested multiple times, and the resulting transmittance curves were completely identical. The instrument test was highly reproducible and stable, and the spectrum is shown in Figure 6.

Conclusion

PerkinElmer LAMBDA series spectrophotometer is equipped with a 150 mm integrating sphere detector for accurate testing and simple operation. The integrating sphere detector is coated with Teflon material, with high reflectivity, low light energy loss, high test accuracy and high stability. Teflon coating has good chemical stability, long-term durability, and is resistant to acidic and alkaline solutions. The 150 mm integrating sphere also has a small opening ratio, resulting in very lowlight leakage and high measurement accuracy.

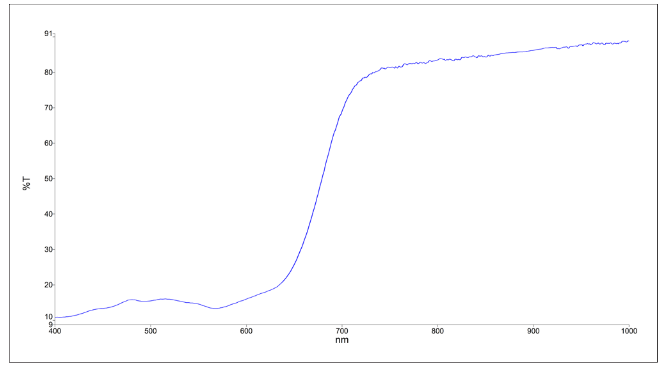

Figure 4. Mobile phone IR hole test spectrum.

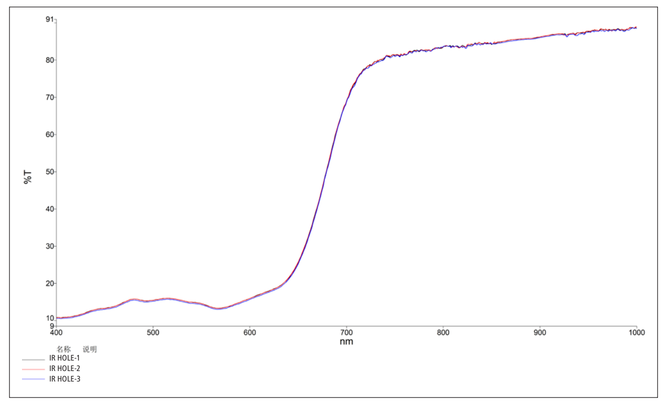

Figure 5. Mobile phone IR hole spectrum from three tests.

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