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Application News

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Spectrophotometric Analysis

Transmittance Measurement of Smartphone Proximity Sensor Window

Currently, smartphone sales have increased to become a large portion of mobile phone sales. Major features of smartphones include a large screen and touch-panel operation.
However, when it is actually used as a telephone, a proximity sensor automatically detects that the ear has moved closer to the phone. This triggers the suspension of operation of the touch panel and illumination of the backlight, thereby preventing malfunctions and draining of the battery. The transmittance of the sensor window is a factor that greatly affects the functioning of this proximity sensor.
Here, we introduce the results of measurement of a smartphone proximity sensor window using the UV-1800 ultraviolet-visible spectrophotometer together with a dedicated smartphone sample holder.

Overview of Proximity Sensor

The smartphone proximity sensor is often installed at the top of the display region. When there is an incoming call and the proximity sensor is covered by the ear, the liquid crystal backlight is switched off to reduce battery power consumption. In addition, touch panel operation is suspended to prevent malfunctions during a call.
Fig. 1 shows a schematic of the proximity sensor. When the ear is brought close to the smartphone during a call, near-infrared light emitted by the infrared LED in the proximity sensor is reflected by the ear. The proximity sensor is designed to conduct ON and OFF control operations for the screen display and touch panel, depending on the detection state of that reflected light.

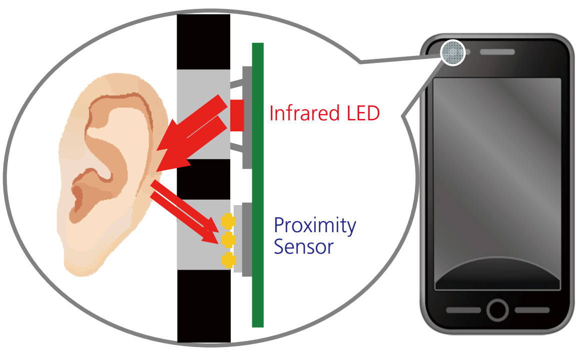

Fig. 1 Illustration of Proximity Sensor

Therefore, it is necessary that the smartphone proximity sensor window maintain high transmittance in the near-infrared region for detection of nearby objects. On the other hand, it is also necessary to reduce the transmittance of visible light from the outside into the smartphone so that its interior is better shielded from visible light. This is why it is extremely important that the proximity sensor window possess the appropriate transmittance characteristics depending on the wavelength region. These transmittance characteristics can be verified using an ultraviolet-visible spectrophotometer.

Sample Holder

The smartphone sensor window is several millimeters in diameter, smaller than the standard beam size of the measurement light(≈10 mm × 1 mm)of a UV-VIS spectrophotometer. For this reason, it is difficult to accurately measure the transmittance as is. With this type of sample, use of a special mask holder (special order part) permits accurate transmittance measurement even with a diameter of about 1 mm. Fig. 2 shows an example of a special mask holder. A 1 mm diameter hole is opened in the holder to focus the measurement light. Measurement is conducted with the smartphone sensor window aligned with the hole. A metal mesh is set at the reference side to dim the reference light. This metal mesh serves to adjust the measurement light and reference light energy balance.

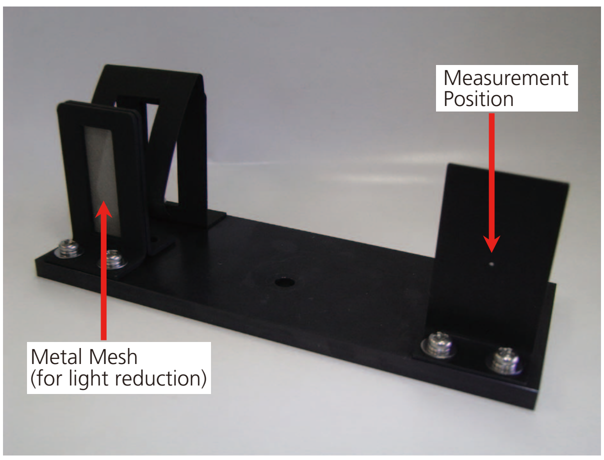

Fig. 2 Sample Holder for Smartphone

Measurement of Proximity Sensor Window

The proximity sensor window was measured using the UV-1800 UV-VIS spectrophotometer. A photograph of the instrument is shown in Fig. 3. After setting the sample holder in the sample compartment, the proximity sensor window was secured in the holder, and measurement was conducted. The baseline was corrected using air only. When a large sample is measured, use of a specialized sample compartment cover (special order) is required. To prevent external light from entering the sample compartment, light-shielding can be accomplished using a shield, such as a blackout curtain.
The measurement conditions are shown in Table 1.

Fig. 3 UV-1800 Spectrophotometer

Table 1 Measurement Conditions

Measurement Wavelength Range	: 380mm - 1000 nm
Scan Speed	: Medium
Sampling Pitch	: 0.5 nm
Measurement Value	: Transmittance
Slit Width	: 1.0 nm (fixed)

Fig. 4 shows measurement results obtained using two different types of smartphone proximity sensor windows. From the measurement results, transmittance was found to be high in the near-infrared region (wavelength greater than 780 nm) for both proximity sensor windows. On the other hand, at a shorter wavelength in the visible wavelength region, transmittance was found to be more greatly suppressed. These transmittance characteristics indicate that both sensor windows provide sufficient sensor function and shield the interior of the phone from visible light.

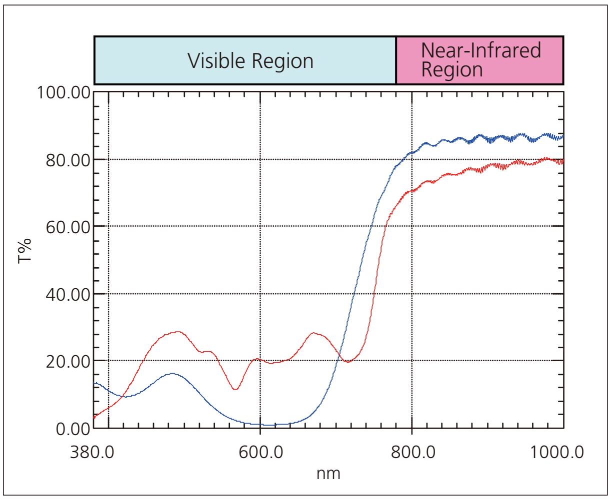

Fig. 4 Transmittance of Proximity Sensor Window

Conclusion

The transmittance of the proximity sensor window and illuminance sensor window in smartphones is an important factor related to the operation of the sensor. Further, with the recent development of smaller and smaller sensors, it has become extremely important to conduct transmittance measurement in extremely small areas.
Here, using a specially designed sample holder, we measured a micro-sized proximity sensor window and confirmed that measurement can be conducted for a target as small as 1 mm in diameter.
There was little scattering with the samples used here. The decrease in transmittance due to scattered light had therefore little effect on the measurement values. In cases where light scattering must be considered due to particular sample characteristics, the use of an integrating sphere may be necessary for accurate measurements.

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