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Application News

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Spectrophotometric Analysis

Measuring Micro-Contaminants on Optical Parts: Measurement and Identification by AIM-9000 Infrared Microscope

Due to the miniaturization and increasingly sophisticated functionality of electrical and electronic devices, an increasing number of optical devices are being used today, such as ultra-small and high-performance semiconductor devices and sensors. However, in such miniaturized devices, micron-sized tiny contaminants can cause the devices to malfunction. Therefore, manufacturers need to determine what caused such contaminants to enter the devices, so their recurrence can be prevented.
Shimadzu AIM-9000 infrared microscope features optics that are designed especially for measuring microscopic areas, and allows users to obtain good spectra in short time even for micron-sized tiny contaminants. The following describes an example of using this system to measure micro-contaminants about 10 μm in diameter on the surface of an optical part.

Micro-Contaminants on an Optical Part

Fig. 1 shows a microscope photograph of the contaminants on the surface of an optical part installed in an electronic device. The contaminants, which are between about 3 and 10 μm in diameter, are lying scattered on a part surface.

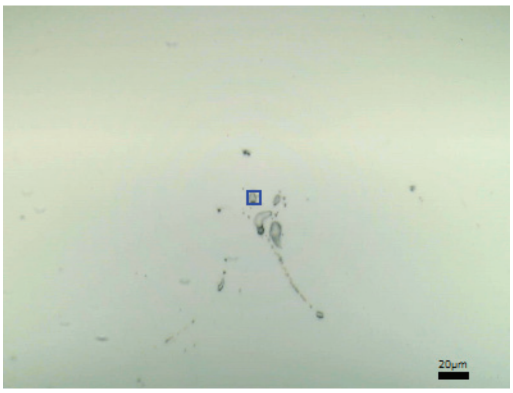

Fig. 1 Microscope Image of Micro-Contaminants (shown with a 10 μm blue box)

Measurement

These contaminants were discovered on a shiny, flat, and smooth metal part surface. Therefore, a measurement using specular reflection spectroscopy is appropriate due to no necessity of sampling the part and the low risk of part damage or loss. An infrared spectrum measured from the contaminant using an infrared microscope by specular reflection spectroscopy and corresponding search results are shown in Fig. 2. Measurement conditions are indicated in Table 1. Even for tiny contaminants only about 10 μm across, a spectrum with minimal noise can be obtained using a short measurement time of only about 20 seconds. Results from analyzing the data using the spectrum library included standard with the system determined that the contaminant is probably a lactate.

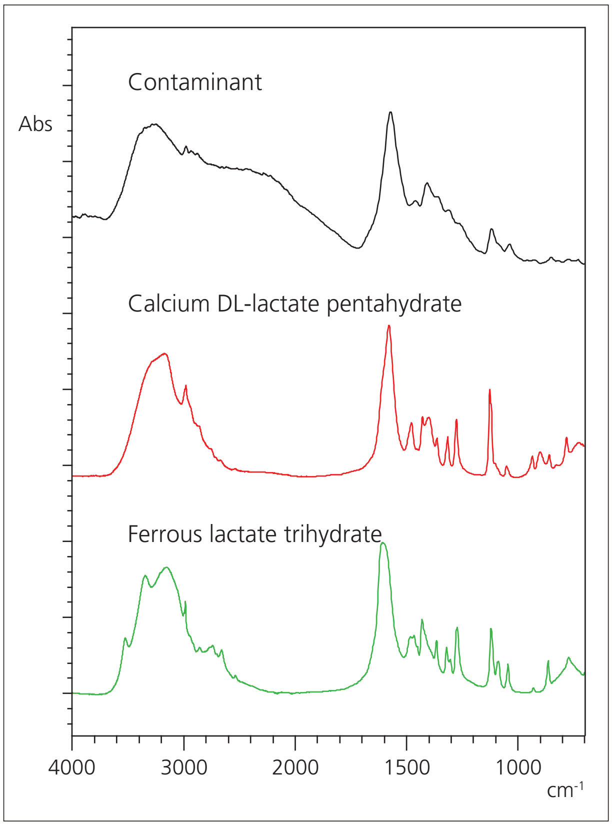

Fig. 2 Infrared Spectrum and Search Results for the Contaminant

Table 1 Measurement Conditions

Instrument	: IRTracer-100, AIM-9000
Resolution	: 8 cm^{-1}
Accumulation	: 40
Apodization	: Happ-Genzel
Detector	: MCT

AIM-9000 Infrared Microscope

Due to the optics that are designed specifically for measuring extremely small areas, the AIM-9000 infrared microscope achieves the highest signal-to-noise ratios (30,000:1) in its class. That means it can obtain excellent spectra very quickly, even from extremely small contaminants. As an example, results from measuring 10 µm polystyrene beads scattered on a BaF_2 window plate are shown. A microscope photograph of the polystyrene beads is shown in Fig. 3. A comparison of measurements obtained by transmission spectroscopy using both the AIM-9000 and the Shimadzu's previous model is shown in Fig. 4. Measurement conditions are listed in Table 2 and a photograph of the AIM-9000 system connected to an IRTracer-100 infrared spectrophotometer is shown in Fig. 5.

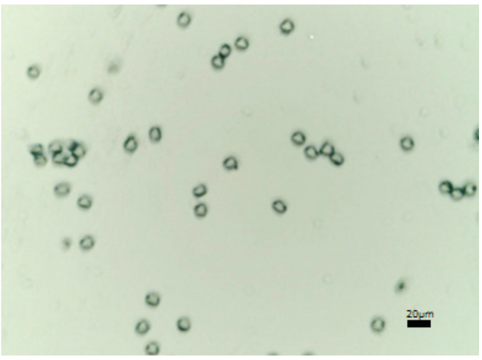

Fig. 3 Microscope Image of Polystyrene Beads of 10 µm in Diameter

Table 2 Measurement Conditions

Instrument	: IRTracer-100, AIM-9000, and previous model (AIM-8800)
Resolution	: 8 cm^{-1}
Accumulation	: 40
Apodization	: Happ-Genzel
Detector	: MCT

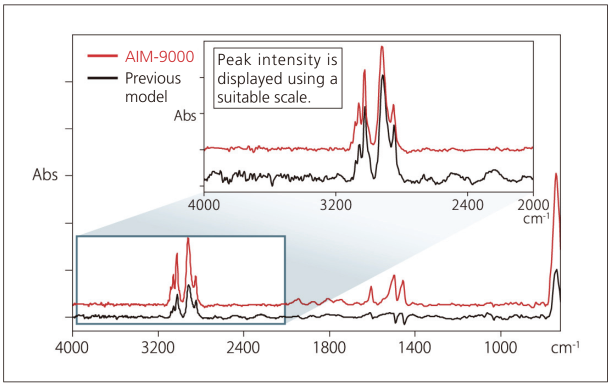

Fig. 4 Infrared Spectra of Polystyrene Beads of 10 µm in Diameter (with Baseline Correction)

These results show that the AIM-9000 detects the polystyrene absorption peaks more clearly and with higher intensity. The inset enlargement shows the results from displaying the spectra with peak intensity matched near 2,920 cm^{-1}. It demonstrates how the AIM-9000 can provide superior spectra with less noise than the previous model.

Conclusion

This article describes measuring micro-contaminants about 10 µm in diameter on the surface of an optical part. The AIM-9000 infrared microscope is ideal for identifying contaminants and analyzing defects in extremely small areas.

Fig. 5 AIM-9000 Infrared Microscope Connected to IRTracer-100 Fourier Transform Infrared Spectrophotometer

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