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Application News

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Spectrophotometric Analysis

Observing and Measuring Contaminants - Advantages of the Wide-Field Camera -

In contaminant analysis, it is important to check for significant differences between the contaminant and normal areas by measuring the contaminant together with an area that is assumed to be normal in the vicinity of the contaminant. If the border between the contaminant and normal area is unclear, the measurement area of the contaminant can be determined by extending the observation area of which is assumed to be normal and sequentially comparing measurements.

The AIM-9000 infrared microscope is equipped with a wide-field camera (option) capable of observing a maximum field of view (FOV) of 10 × 13 mm. This enables efficient observation and checking over an extended range of a measurement area that includes contaminants. In this article, we introduce an example of using the wide-field camera in contaminant analysis.

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Wide-Field Camera

The microscope camera installed on general infrared microscopes performs image observation via a reflection objective mirror used in infrared spectrum measurement and the FOV is limited to a very narrow range of about a few hundred square μm.

In addition to the conventional microscope camera, the AIM-9000 is equipped with a wide-field camera that enables wide-field observation which facilitates observation and checking of measurement targets with good efficiency over an extended range. The wide-field camera is capable of observing at a size visible to the human eye (FOV of 10 × 13 mm) and also features a variable digital zoom function with maximum 5x magnification (2.0 × 2.6 mm).

Observation of a Contaminant Adhered to an Electronic Component

(1), (2), and (3) in Fig. 1 show observation images of an electronic component captured using the wide-field camera. Observation using the wide-field camera revealed what looked like a contaminant on the right of the letter "J." Switching to the high-magnification microscope camera, (4) and (5) in Fig. 1 show observation images of a contaminant in the area right of the letter "J." A contaminant about 30 × 40 μm in size is clearly visible. Since position information is shared by the microscope camera and wide-field camera, switching cameras does not shift the FOV, thereby allowing observation to proceed smoothly. Furthermore, the microscope camera features a 10x digital zoom (0.03 × 0.04 mm) function, which provides a total magnification range of 330x from the FOV of the wide-field camera. Using the wide-field camera enables smooth, sequential operation from observation at a wide FOV through to confirming the positions of minute contaminants.

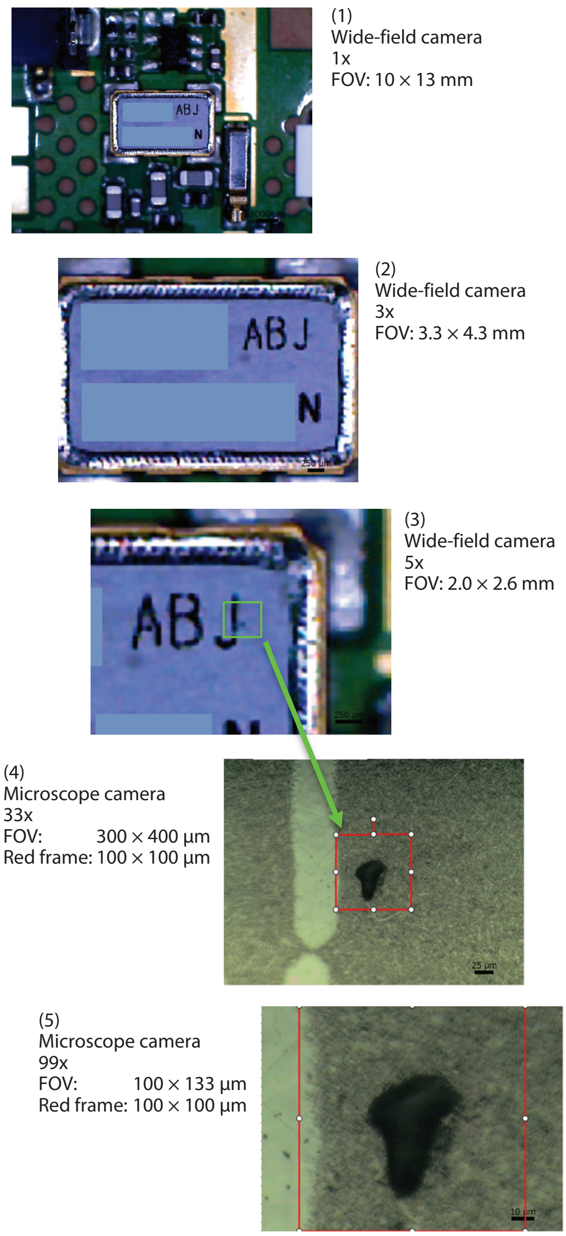

Fig. 1 Electronic Component Observation with Wide-Field Camera and Microscope Camera

Observation and Measurement of Contaminants Adhered to a Coin

Contaminants adhered to a coin were observed and measured. Fig. 2 shows observation images of the coin surface captured using the wide-field camera. Green and white contaminants can be observed to the right of center on the coin.

The wide-field camera features independent illumination from four directions that can be adjusted by selecting which lights to turn on and off in order to obtain optimal illumination. This is useful when, for example, observation is difficult due to bright reflected light. The right image in Fig. 2 shows illumination weakened, enabling a clear view of contaminants compared to the left image.

Next, the background (BKG) was set to a clean area near the contaminants and the contaminants were measured using the reflection spectroscopy. Fig. 3 shows tiling images of the coin surface captured using the microscope camera and the measurement positions. The yellow flag indicates the BKG measurement position and the blue flags indicate the sample measurement positions.

The left image in Fig.3 shows the BKG measurement position set above the contaminants and Fig. 4 shows the spectra measured in this state.

Table 1 lists the measurement conditions. Depending on the measurement position, some peaks of the absorbance spectra are inverted downward. This likely occurred because contaminants that could not be verified in the image exist at the BKG measurement position and the amount of these contaminants is less at the sample measurement position compared to the BKG measurement position, thus causing corresponding peaks to invert downward.

Next, the right image in Fig.3 shows the BKG measurement position set below the contaminants and Fig. 5 shows the spectra measured in this state. This time the peaks of all the spectra are facing upward meaning that the set BKG measurement position was appropriate.

The spectra of the contaminants resemble the spectra of a carboxylate, such as alginate, and fat/oil (library spectra are not shown), which points to a mixture derived from food and food additives. From this result, we could conclude that these contaminants adhered to the coin during the course of circulation.

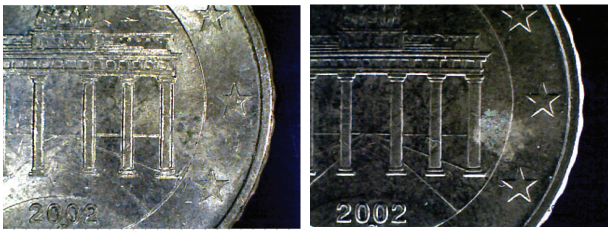

Fig. 2 Observation Images of Coin Surface Captured Using the Wide-Field Camera
Left: Bright State, Right: Dark State

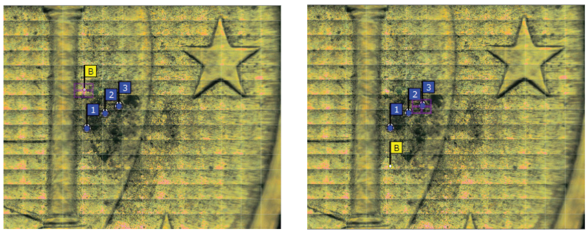

Fig. 3 Tiling Images of Coin Surface Captured Using the Microscope Camera and Measurement Positions
Left: BKG Measurement Position Set Above Contaminants
Right: BKG Measurement Position Set Below Contaminants

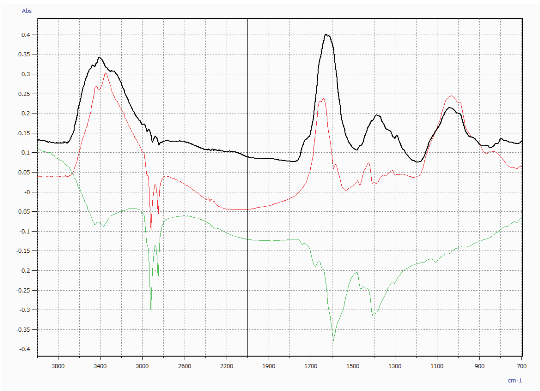

Fig. 4 Measurement Results for BKG Measurement Position Set Above Contaminants
Sample Measurement Positions: 1: Black, 2: Red, 3: Green

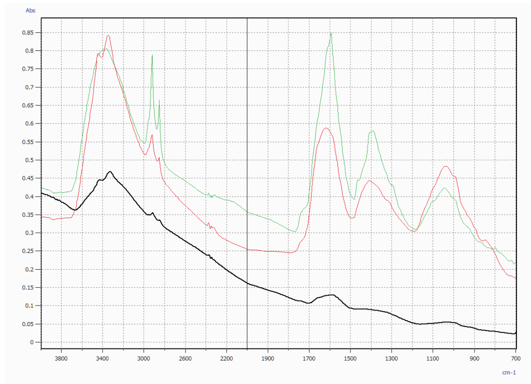

Fig. 5 Measurement Results for BKG Measurement Position Set Below Contaminants
Sample Measurement Positions: 1: Green, 2: Red, 3: Black

Table 1 Measurement Conditions

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

Summary

We introduced an example of using the wide-field camera in contaminant analysis. The wide-field camera enables efficient observation and checking over an extended range of a measurement area that includes contaminants. It also reduces the workload of setting and changing BKG measurement positions and sample measurement positions, thereby facilitating rapid acquisition and evaluation of contaminant spectra.

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