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Application News

No.A521

Spectrophotometric Analysis

Printed Circuit Board Defect Analysis

Contaminants and stains on printed circuit boards can cause conduction defects. Identifying these materials is an important part of preventing the same problem occurring again.
We describe a qualitative analysis of contaminants found on a printed circuit board performed using the AIM-9000 Infrared Microscope, which is specially designed for defect analysis.

Contaminants/Stains Found on Printed Circuit Board

Contaminants and stains found on the terminal of a microSD™ [1] card were analyzed. Fig. 1 shows an image of the microSD™ card placed on the sample stage of the AIM-9000, captured with a wide field camera. Almost the entire card is within the field of view. Using a wide field camera allows observation of a wide area around the defect with a field of view of approximately 10 mm × 13 mm. Positional information is shared between the wide field camera and a 15X reflection objective mirror that will be used for analysis. Once a defect is found with the wide field camera, the operator can switch to a 15X reflection objective mirror view of the same location, and only need to adjust image focus. This feature makes it easy to bring a defect within the analytical field of view. An auto-centering function is also included as standard. This function automatically moves a desired position on the sample stage to the middle of the field of view by simply double-clicking a point on the wide field image or microscope image. This can be useful for analyzing electrical products with multiple terminals.

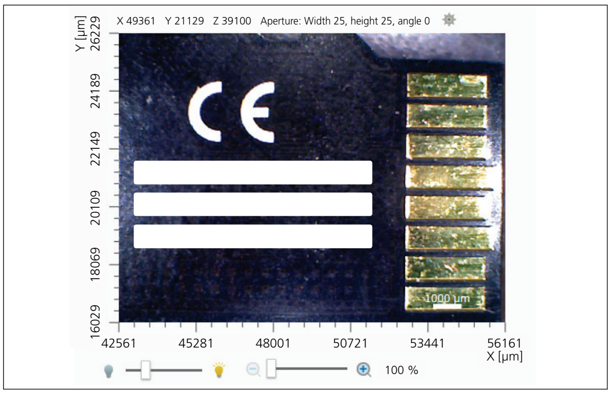

Fig. 1 Wide Field Camera Image of microSD™ Card

Measurement

Methods of analyzing contaminants on a terminal surface and other parts of a printed circuit board are broadly divided into two types: specular reflection and attenuated total reflection (ATR). For specular reflection microspectroscopy, incident light is absorbed by the sample as it passes through the sample, and light reflected by the circuit board is detected by a detector. This creates similar spectra to those obtained by the transmission spectroscopy, and measurements can be performed without touching the sample. This method is suited to sample thicknesses of around 10 µm. Contamination or staining that is too thick can result in saturated peak tops, and contamination or staining that is too thin can result in indistinct peaks. For ATR microspectroscopy, peak saturation is not affected by sample thickness, but the sample must be in contact with a prism for measurements to be taken. This contact can cause issues such as losing the sample during measurement, or difficulty involved in achieving contact due to sample shape.

Measurement by Specular Reflection Microspectroscopy

Measurements were performed by specular reflection microspectroscopy which requires no contact with the sample. Fig. 2 shows an image of the defect for which a specular reflection spectrum was measured. The blue box shows the location of contamination on the sample. Aperture size was set to 25 µm × 25 µm. Analytical conditions are shown in Table 1, and the spectrum obtained and a library spectra search result are shown in Fig. 3. The contaminant spectrum matched the spectrum for magnesium silicate (talc).

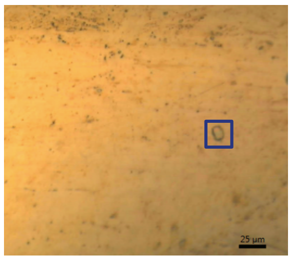

Fig. 2 Microscope Image of Contaminant (blue box size: 25 µm × 25 µm)

Table 1 FTIR Analytical Conditions

Instrument	: IRTracer™ [2] -100, AIM-9000
Resolution	: 8 cm^{-1}
Accumulation	: 20
Apodization	: Happ-Genzel
Detector	: MCT

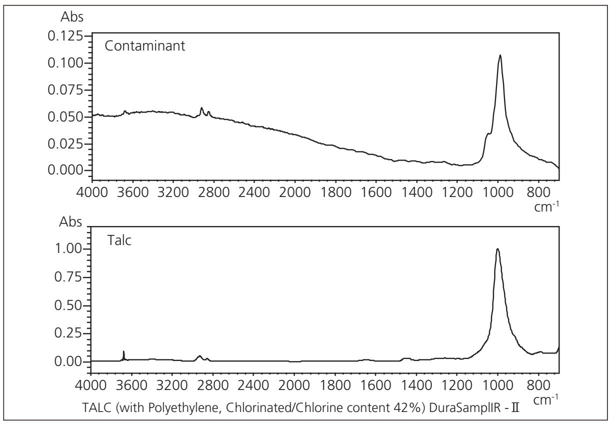

Fig. 3 Library Spectra Search Result (Top: contaminant, bottom: library spectrum for talc)

Measurement by Specular Reflection and ATR Microspectroscopy

As mentioned above, when analyzing thick samples, good spectra may be obtained by ATR microspectroscopy but not by specular reflection microspectroscopy. Both specular reflection microspectroscopy and ATR microspectroscopy were used to analyze a thin, stain-like contaminant. A visual field image of the stain is shown in Fig. 4, and analytical conditions are shown in Table 2. Aperture sizes were 25 µm × 25 µm for specular reflection measurements and 50 µm × 50 µm for ATR measurements. The respective spectra obtained are shown on the same graph in Fig. 5.

Table 2 FTIR Analytical Conditions

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

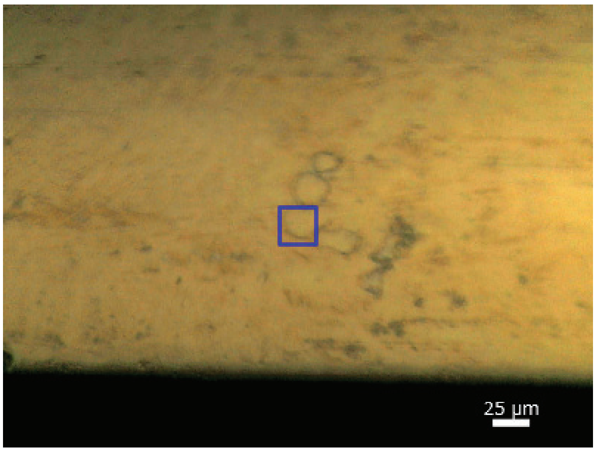

Fig. 4 Image of Stain on Printed Circuit Board (blue box size: 25 µm × 25 µm)

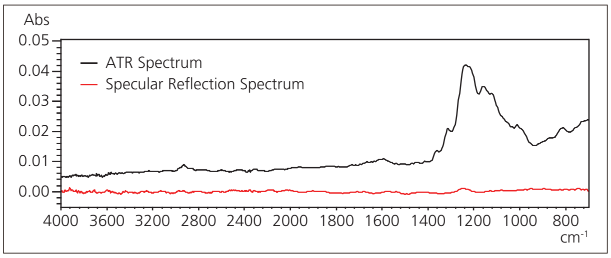

Fig. 5 Specular Reflection Spectrum and ATR Spectrum of Stain

With specular reflection microspectroscopy the peak intensity is lower overall and shows a very slight peak at around 1250 cm^{-1}, though not distinct enough for qualitative analysis. The same position measured by ATR microspectroscopy resulted in a more distinct spectrum compared to specular reflection microspectroscopy. A library spectrum search for the ATR spectrum gave the results shown in Fig. 6, with a fluorinated lubricant and a fluorine resin appearing at the top of the list. It was presumed that a thin layer of a fluorine-containing lubricant was adhered to the metal substrate.

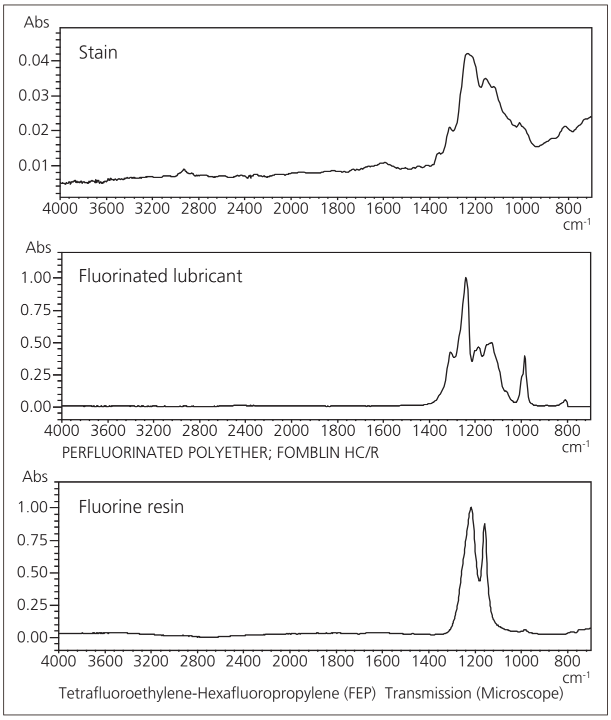

Fig. 6 Spectrum Search Result (Top: stain ATR spectrum, middle: fluorinated lubricant library spectrum, bottom: fluorine resin library spectrum)

Conclusion

Qualitative analysis was performed on contaminants found on the terminal of a microSD™ card. The wide field camera of the AIM-9000 was used to examine a wide area of the sample and determine the contaminant position for analysis.
Choosing between using specular reflection microspectroscopy and ATR microspectroscopy of analysis based on contaminant shape allows the operator to obtain better spectra.

1) microSD™ is a trademark or a registered trademark of SD-3C, LLC in the United States, other countries or both.
2) IRTracer™ is a trademark or a registered trademark of Shimadzu Corporation in Japan, other countries or both.

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