Automated Conformal Coating Inspection & Thickness Measurement

Hector L. Fonseca
Sr. Applications Engineer
Nordson Yestech, Advanced Technology Systems
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Conformal Coating background

A conformal coating is a protective barrier that shields sensitive electronic components against harsh environmental conditions such as moisture, chemicals and debris. Its advantages can be summarized as follows:

• Light weight, highly flexible & fairly simple to apply.
• Completely protect the assembly against chemical and corrosive attack.
• Eliminate potential performance degradation due to environmental hazards.
• Protection against thermal and mechanical shock.
Similar to the previous production stages, quality of applied coating must be assured. After coating the assembly, proper wetting is mostly visibly checked by manual means, with the usual manual optical inspection disadvantages:

- Inspection & hazard awareness training are required.
- Results are dependent by Inspector experience + Inspector to Inspector variability.
- Requires higher working space allocation.
- Increased work in progress WIP.
- Inadequate product handling.
- Non or reduced traceability and data storage.
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Choose Your Wavelength

[Image of the electromagnetic spectrum with wavelengths labeled: Radio, μWave, IR, Visible, UV, X-ray, Gamma]
Automated Conformal Coating Inspection & Thickness Measurement Technology used in ACI

Same as AOI, ACI are systems where an assembly of cameras, lighting and X-Y stage autonomously scans the PCB taking images that are analyzed by a processing software, basically by converting images to BLOBs and analyzing pixel brightness and coverage of required areas, the only difference in ACI is that the lighting used is UV.

With minimal programming, the inspection setup is fast and intuitive typically requiring less than 30 minutes. A known good board is used to learn the coverage and non-coverage areas. Same as AOI, its main advantages includes:

- High Throughput, 1.5X – 50X magnification
- Cycle time: <20 seconds
- Increased traceability, since can also read a barcode on PCB and store the inspection results on a database.
- High repeatability & non Operator dependent.
- Small foot print.
- In line set up capability.
Blob analysis allows to identify connected regions of pixels within an image, then calculate selected features of those regions (same logical pixel state based on a given determined criteria).

Software uses a user-specified blob identifier to discriminate between blobs and the background, afterwards, can calculate a variety of different blob measurements or features, such as the area, dimensions, etc.

Each pixel in your image represents a real width and height (for example, in microns). However, all results from the blob analysis functions are expressed in raw pixel units. Based on camera magnification, software converts these results to actual physical units.

Patter Matching will also help to inspect SMT or different components (transformers, shields, connectors, etc)
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Applications / Algorithms Examples

No Coating / Coating Insufficiency
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Applications / Algorithms Examples

Keep Out Zones
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Applications / Algorithms Examples

Coating Delamination
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Applications / Algorithms Examples

Bubbles
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Applications / Algorithms Examples

Maximum / Minimum Width

Width (Avg) & Angle Offset

Count / Pitch / Regularity / Dispensed Area
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Dual AOI / ACI Capability

Standard AOI lighting + side angle cameras can also be maintained in order to have Dual AOI / ACI capability. Therefore standard AOI can also be performed before or after ACI, to inspect for typical SMT assembly defects.
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Inline AOI/ACI - Quick Defect Reports - SPC Web-based Reporting

- Easy to read visual defect reports highlight failed coating areas on PCB.
- Real-time SPC Monitoring
- Email Alarm Recipients
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Conventional Thickness Measuring Methods

Another critical factor in conformal coating process control, is to ensure that thickness is within internal and international standards, which is typically done by non-destructive coating thickness gages. Thickness measurement is important to check the necessary protection level & may be critical in preventing long-term product reliability issues after assembly.

There are several methods divided into two categories, wet film measurements applied during coating application and dry film measurements made after the coating is dried enough not to damage the coating. Since most of them are manual methods, previous associated disadvantages also applies to them.
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Technology Used – Spectral Interference Laser Displacement Meter

By integrating into the AOI system the existing technology of a Spectral-interference Laser Displacement Meter, a measurement device that uses as light source an infrared Super Luminescent Diode to emit bands of broad wavelengths that reflects between top and bottom surfaces of the coating to a Charge-Coupled Device, coating thickness measurements can be obtained across the surface of coated circuits boards and be used within software algorithms, in conjunction with AOI cameras and X-Y-Z stage, as a pass / fail criteria for each inspected board.
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Application Example
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Study 1

System cycled over same spot, > 20k times
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Repeatability Analysis

Study 2

System cycled over same spot of 4 different coatings in different points of the scanning area of the FX940, 100 times
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Conclusion

After successfully integrating ACI / Thickness Measurement techniques to existing AOI systems, low and high volume EMS companies can now accurately and objectively inspect and record valuable data at high speeds, and use it to improve their process and reliability of their products.
Questions?
Thanks!

For more information contact:
Nordson YESTECH
2762 Loker Ave West
Carlsbad, CA 92010
www.yestechinc.com