3D Optical Microscopy Advances Speed MCM Panel Inspection

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As smart phones and tablet computers become more and more prevalent, multichip modules (MCMs) are increasing in popularity because they offer a number of advantages over traditional packaged ICs.

Smaller-size MCMs enable longer battery life and increased performance due to the lower lead inductance and capacitive leading that derives from shorter interconnect lengths between die.

Addressing MCM Defect Challenges

As MCMs incorporate a greater number of components, interconnect density increases, even while individual feature dimensions shrink, creating new metrology challenges.

A major solution for MCM defect detection is provided by the latest generation of 3D optical microscopes, designed specifically to address these challenges.

MCM components are usually mounted un-encapsulated on a multi-layer PC board panel with the bare die connected to the surface by wire bonding, bumping or flip-chip technology.

The module is then over-molded and mounted on the main system PC board in the same way as any other quad flat package (QFP) or ball grid array component (BGA).

MCMs provide a small, overall package compared to the individual components, so they save space and reduce I/O to the system board.

MCM technology is advancing rapidly, and these improvements are driving the use of new processes, new structures and the aggressive scaling of dimensions for MCM interconnects.

Metrology for Newer Structures

The attributes needed for the metrology to measure the newer, smaller structures includes the ability to repeatably and quickly characterize the width, pitch and height of traces, surface roughness, solder resist thickness and via dimensions.

Voids and the bridging of metal lines and vias, as well as other defects, also must be identified because they are common causes of yield loss.

Traditionally, most MCM manufacturers have employed 2D stylus profilometers to measure the features of the panel substrates.

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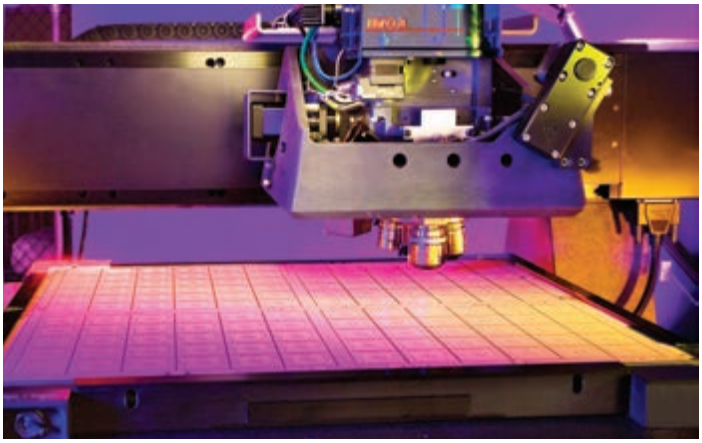
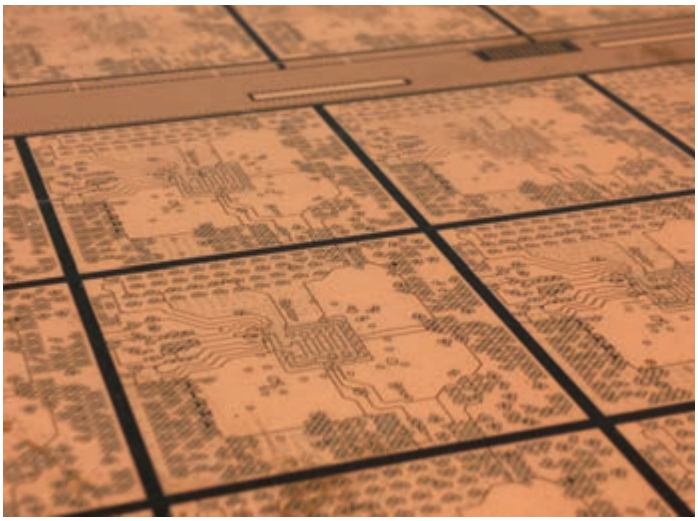


A 3D optical microscope measures an MCM panel.

3D Optical Microscopy (Continued)



Close-up of the MCM panel shown in the prior photo.

Contact-Based Measurements Slow

Although contact-based stylus measurements can be accurate for certain tasks, they are typically slow and offer limited functionality for high-volume MCM panel production.

With stylus systems, the MCM panel is generally scanned along several ***X*** and ***Y*** lines to capture the height, width and pitch of traces along these lines. Unfortunately, this approach is capable of detecting problems only along the specific lines that are scanned.

Due to these limitations, over the past decade many suppliers within the MCM industry have switched to 3D optical microscopes for the inspection of panel substrates.

These instruments generally use white light interferometry to measure traces, vias, solder resist thickness and surface roughness with great accuracy.

In a 3D optical microscope based on white-light interferometry, refected light from the sample under test is compared to reflected light from a high-quality reference.

The microscope is scanned vertically with respect to the surface, so each point of the test surface passes through best focus.

Best Focus Position Indicated

The maximum of the combined signal from the light reflected from the test and reference surfaces indicates the best focus position for each pixel, and an extremely accurate surface map is generated.

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The first generation of 3D optical microscopes for MCM panel metrology provided a major improvement for the industry by integrating support for samples with large areas and gantry-mounted optical heads to reduce the system footprint.

This integration provided the ability to perform measurements over the entire panel surface, eliminating the need to contact the sample. It also delivered substantial improvements in measurement speed.

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3D Optical Microscopy (Continued)

Now, to meet the complex metrology of larger panel sizes, higher interconnect densities and smaller feature sizes, the current generation of 3D optical microscopes incorporates many useful features.

These include higher contrast LED illumination and sophisticated automation hardware and software to improve process monitoring and enable increased yields and lower production costs.

Recent engineering improvements have led to faster traverse speeds, faster autofocusing, faster cameras and better fixture loading mechanisms.

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The technology has not only kept up with evolving metrology requirements, but in some cases is actually enabling the development of next-generation MCM improvements.

Conclusion

The present capabilities of 3D optical microscopy offer MCM panel manufacturers extremely fast characterization of large panels and PC boards without sacrificing accuracy or repeatability. The ultimate result is improved yield and lower consumer cost for electronics.

A 3D optical microscope system enables improved yield.

Dr. Novak is a market applications development manager for Bruker Nano Surfaces Division - Stylus and Optical Metrology.

He has 15 years' experience in the development of metrology products and systems across a range of applications. He earned his doctorate in optical sciences from the University of Arizona while working for a metrology capital equipment manufacturer.