

Enhancing High Bandwidth Memory (HBM) Reliability with 3D X-ray Inspection

Application Story

Introduction

High Bandwidth Memory (HBM) is revolutionizing AI, high-performance computing, and advanced graphics systems. Its 3D architecture—stacked DRAM dies interconnected via Through-Silicon Vias (TSVs)—delivers exceptional bandwidth and efficiency. But this complexity introduces new challenges for inspection and quality assurance.

Why 3D X-ray for HBM?

Traditional 2D X-ray imaging cannot fully visualize the intricate internal structures of HBM stacks. 3D X-ray computed tomography (CT) provides a non-destructive, volumetric view, enabling engineers to detect defects that could compromise performance or reliability.

- TSV integrity analysis
- Micro-bump and die-to-die bond inspection
- Die shift and alignment
- Void and inclusion analysis

Nordson Quadra Pro: Two Advanced Methods

1. Micro CT

Micro CT provides full volumetric 3D reconstruction of the entire component, delivering a comprehensive view of internal structures. This method is ideal for complete structural analysis, research and development, and detailed failure analysis. By capturing high-resolution images throughout the entire volume, Micro CT enables engineers to detect critical defects such as voids, cracks, TSV misalignment, and warpage, ensuring the highest level of accuracy and reliability in inspection.

2. X-Plane Pro

X-Plane Pro is designed to deliver limited-angle 3D imaging for larger samples, making it an excellent choice for high-throughput environments. This method focuses on speed and efficiency, enabling rapid inspection of specific layers without scanning the entire volume. It is particularly well-suited for targeted defect detection in production settings, where identifying issues such as micro-bump misalignment, voids, and structural anomalies quickly is essential for maintaining yield and reliability.

Comparison Table

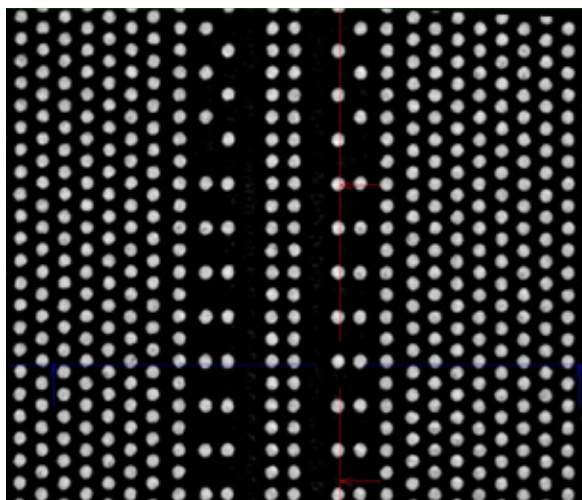
Comparison: Micro CT vs X-Plane Pro

	Micro CT	X-Plane Pro
Imaging Type	Full volumetric 3D reconstruction	Limited angle 3D for larger samples
Resolution	Submicron, ideal for detailed analysis	High resolution per slice, optimized for speed
Inspection Speed	Slower (full volume scan)	Faster (selective layer inspection)
Best For	Complete structural analysis, R&D, failure analysis	High-throughput production, target checks
Defect Detection	Engineering labs design validation	Inspection in manufacturing environments

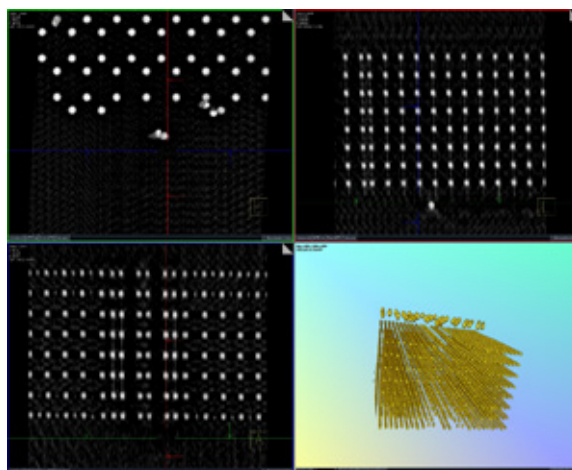
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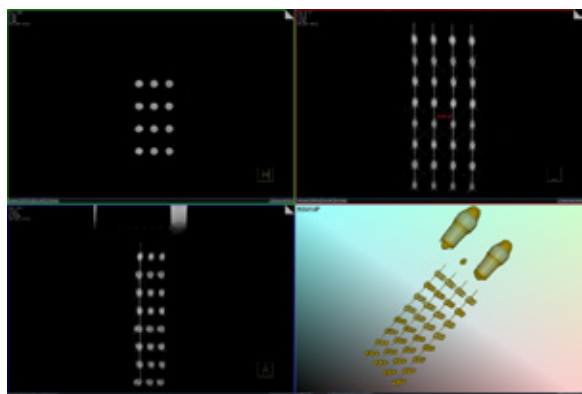
Visual Examples



Micro-bump array inspection using Quadra Pro



Full 3D reconstruction of HBM stack



TSV and interconnect analysis

Benefits for Manufacturers

Implementing advanced 3D X-ray inspection methods such as Micro CT and X-Plane Pro offers significant advantages for manufacturers. These technologies help improve overall yield and product reliability by identifying defects early in the production process, reducing costly rework and scrap. They also minimize field failures and lower return material authorization (RMA) rates, ensuring greater customer satisfaction and trust. Furthermore, by accelerating failure analysis and root cause investigations, manufacturers can resolve issues faster and maintain production efficiency. Finally, the detailed structural feedback provided by these inspections supports design optimization, enabling engineers to refine processes and develop more robust, high-performance components.

For more information, speak with your Nordson representative or contact your Nordson Test & Inspection regional office

Europe, SEA, Africa

ti-sales-eu@nordson.com

China

ti-sales-cn@nordson.com

Singapore

ti-sales-eu@nordson.com

Korea

ti-sales-korea@nordson.com

Americas

ti-sales-us@nordson.com

Japan

ti-sales-jp@nordson.com

Taiwan

ti-sales-tw@nordson.com