



# Advancing Semiconductor with X-ray Precision

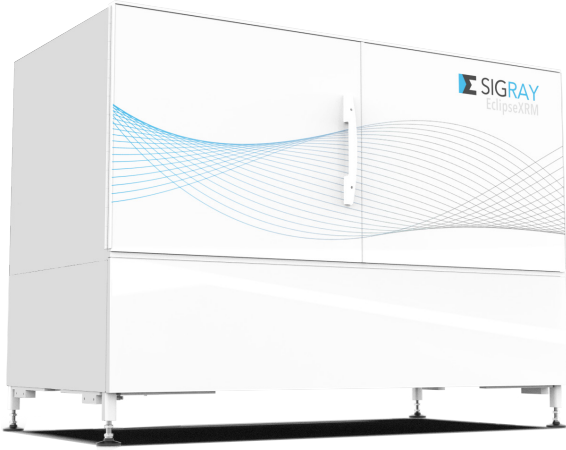
METROLOGY AND FAILURE ANALYSIS SOLUTIONS

## **Sigray, Inc.**

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# Transforming Semiconductor Inspection

Solutions for Next-Generation Failure Analysis, Process Development, and Yield Optimization



## ECLIPSE XRM 3D Nanoscale X-ray Microscopy

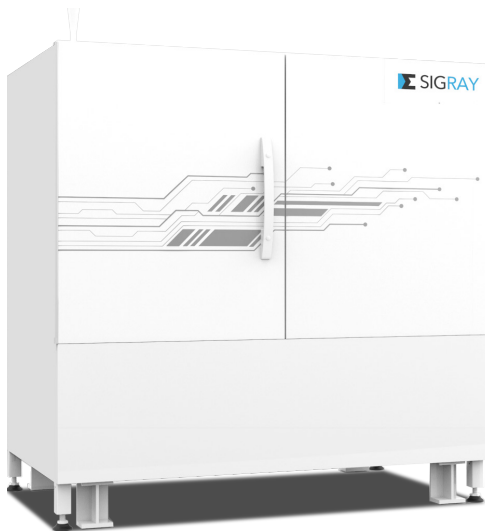
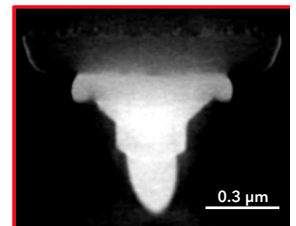
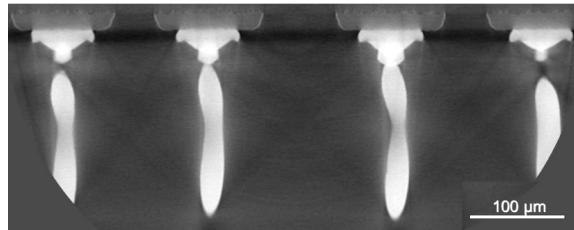
**Purpose-Built for Advanced Semiconductor Failure Analysis**

**What:** Sub-300 nm resolution 3D X-ray microscope

**Why:** Failures in advanced packaging are decreasing in dimension, necessitating higher resolution 3D microscopy

**Applications:**

- High-resolution inspection of microbumps, TSVs, and hybrid bonds
- Best-in-class resolution for challenging defects



## APEX 3D X-RAY Laminography for Wafers, Panels, & PCBs

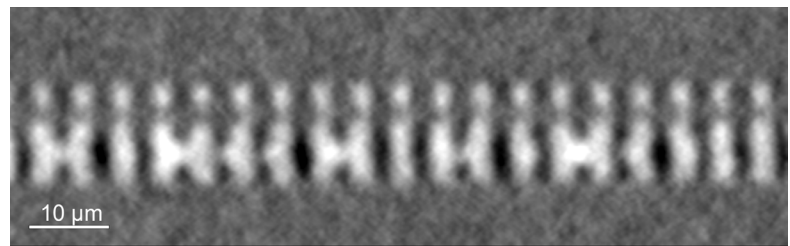
**Redefining Throughput and Clarity for 3DHI, Boards, and In-Line Analysis**

**What:** Rapid Imaging at resolutions of down to <350 nm (Apex-Hybrid)

**Why:** Large samples at fast acquisition speeds down to minutes

**Applications:**

- Failure analysis of large PCBs and wafers (with laboratory Apex version)
- At-line metrology of advanced packaging, such as microBumps and TSVs (with fully automated Apex)





## ATTOMAP XRF Dopants & Thin Films

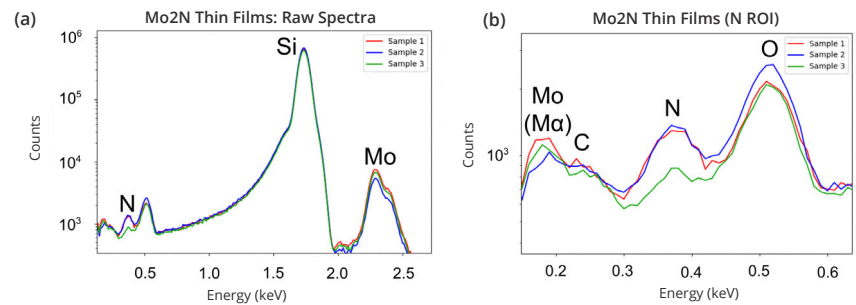
### Sub-Angstrom Sensitivity within Seconds

**What:** Highest sensitivity microXRF for all elements, even down to B, O, Al

**Why:** Residue, dopant, and thin film measurements with <20  $\mu\text{m}$  spot size

#### Applications:

- Sub Angstrom of F, Al, Ge, Mo, and N for advanced logic & memory
- At-line metrology of patterned and blanket wafers (with fully automated AttoMap version)



## XADA X-ray Assisted Device Alteration

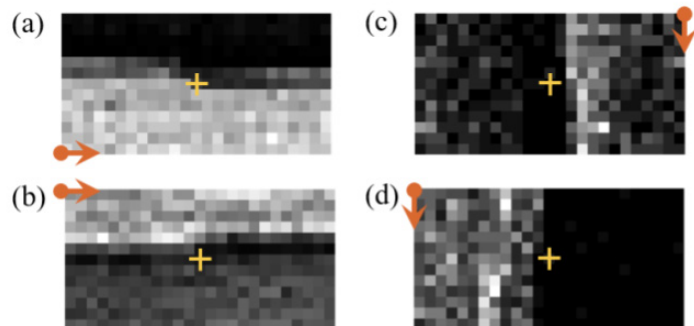
### Electrical Fault Isolation for BPD Architectures

**What:** Circuit debug and localization of both soft and hard defects

**Why:** Backside Power Delivery necessitates x-ray penetration

#### Applications:

- Isolation of critical speed paths in Devices Under Test (DUT)
- Localization of hard failures such as shorts and opens



# Patented Innovations for Next Gen Metrology

Technology Differentiators Critical for Semiconductor Architectures

## Breakthroughs in X-ray Source, Optics, and System Architectures

Sigray's patented X-ray source technology uses microstructured metallic anodes on a diamond substrate, overcoming the thermal and performance limits of conventional bulk metal anodes. This design achieves brightness comparable to high-end rotating anode sources—without the bulk, complexity, or maintenance. Software-selectable, motorized X-ray targets provide distinct spectra, each optimized to specific semiconductor applications. Paired with Sigray's proprietary double-paraboloidal X-ray optics, this system delivers up to ten times greater brightness and performance.

Such source and optics innovations power Attomap XRF for atomic-level elemental analysis and XADA for next-generation electrical fault isolation, while patented system architectures enable Sigray's imaging tools (EclipseXRM and Apex XCT).

Relevant Patents: US 9,543,109; US 10,466,185; US 10,658,145; US 10,991,538; EP 3168856

## Relevance to the Semiconductor Industry

As the semiconductor industry advances toward heterogeneous integration, nanosheet transistors, backside power delivery, and ultra-dense interconnects, conventional metrology and failure analysis methods are increasingly outpaced. The modern semiconductor market demands a suite of tools capable of non-destructively characterizing both Front-End of Line (FEOL) and Back-End of Line (BEOL) features with high accuracy, sensitivity, and speed.

Sigray's suite of solutions encompasses X-ray Microscopy (XRM), Attomap XRF Microscopy, and XADA (X-ray Assisted Device Alteration), purposely-built to meet these new demands.

## About Sigray

Sigray is a next-generation X-ray instrumentation company headquartered in San Francisco Bay Area. Founded and led by industry visionaries, Dr. Wenbing Yun and Sylvia Lewis—redefining the landscape of non-destructive imaging, elemental analysis, and electrical fault isolation.

With over 70+ issued U.S. (with 30+ pending) and international patents, our systems are trusted by world-class universities, global foundries, and leading industrial labs across the globe—where precision, innovation, and performance are non-negotiable. At Sigray, we're not just building tools; we're enabling breakthroughs.



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