

X-RAY METROLOGY AND DEFECT INSPECTION
X200

Improve Process Control Systems with Precise,
Real-Time Metrology and Defect Feedback

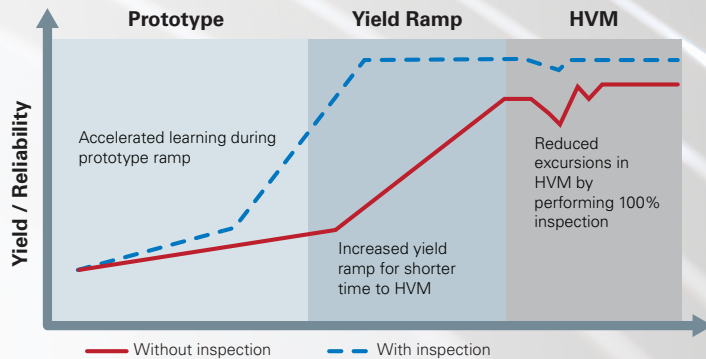
X200 Paves the Path Toward Zero Defects

High-Resolution In-Line Transmissive X-Ray Inspection and Metrology

As advances in semiconductor devices demand tighter tolerances, smaller interconnects, and more vertical layers, product quality and reliability need to be ensured by quickly, accurately, and non-destructively identifying latent defects early in the manufacturing process. Bruker's X200 combines high speed and high resolution for a one-of-a-kind, no-compromises, in-line X-ray defect inspection solution. X200 uses proprietary data collection architecture, industry-leading data processing, and innovative machine learning techniques to provide fully automatic, fast, 100% inspection and real-time feedback.

Only the X200 delivers:

- No-compromise rapid, high-resolution X-ray imaging to find even the smallest latent defects across a full die within seconds
- Full automation from imaging through data processing, with real-time feedback for continuous use on the manufacturing floor
- Leading-edge Data Analysis Toolkit with image processing-based machine learning algorithms to expedite and standardize defect identification



Including metrology process feedback into the production process is the key to:

- Achieving a defect rate <100 ppb
- Reducing excursion discovery time from weeks to days
- Accelerating learning during prototype ramp
- Minimizing time to high-volume manufacturing (HVM)

Increasing sampling rate during metrology process feedback improves yield and decreases excursion days significantly.

Real customer data shows how much the 100% sampling rate of the X200 can improve total yield and decrease monthly excursion days.

Sampling Rate

4%
sampling
previously



100%
sampling
with X200



Total Yield



Excursion Days

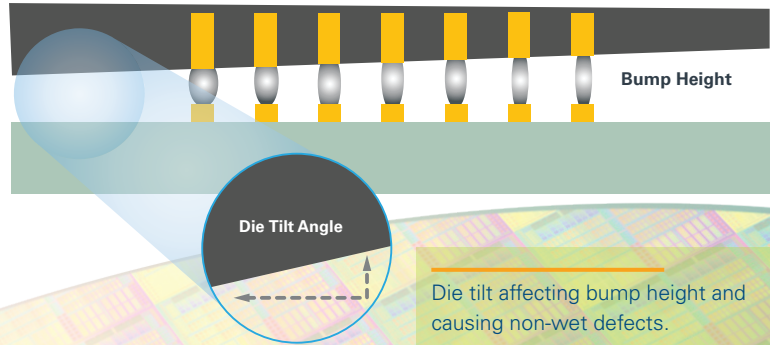
50+

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Redefining X-Ray Defect Inspection

X-ray imaging (XRI) is an effective way to catch defects that are not visible on the surface of a substrate, since X-rays penetrate further into materials than light or electrons. There are different categories of XRI, but the most common uses attenuation contrast to take advantage of the differing X-ray absorption coefficients of materials.

With the X200, Bruker has optimized X-ray imaging to make full defect inspection feasible in-line on the manufacturing floor. Instead of pulling a small sample from the line for lengthy and data-limited 3D X-ray and cross-sectioning, 100% of production can be automatically monitored in real-time for maximal quality, reliability, and production yield.

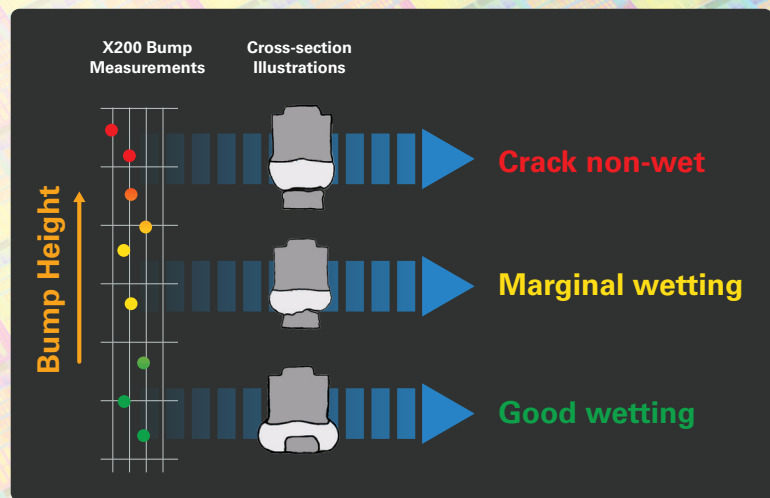


Resolving Process versus Defect

Defect detection does not require resolving each defect for visualization. The X200 provides a continuous measure of bump quality that can be used for pass-fail qualification as well as binning for device performance and reliability.

Defect Screening

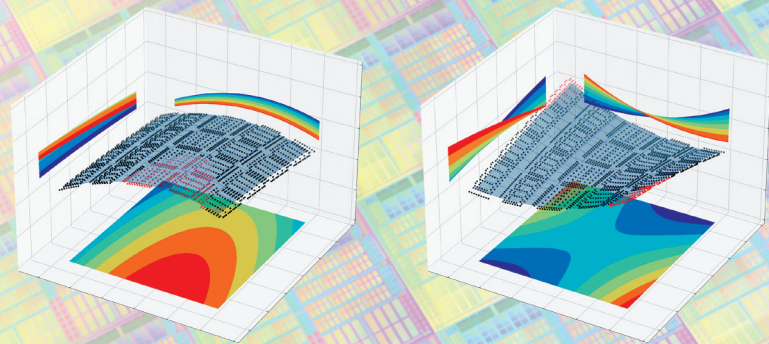
- Flag bump defects including bridges, non-wets, and voids
- Use sensitive metrics to detect latent defects, such as solder necking, head-in-pillow, crack non-wet, and other marginal bumps
- Create automatic defect classification models to quickly identify failure modes



The X200 can measure bump height, a predictive indicator of wetting behavior. This requires no cross-sectional or high-resolution defect imaging beyond initial validation step.

Die-Attach Process Control

- Measure each bump shape across entire device to assess quality of die-attach process
- Provide corrective feedback to die-attach tools on process parameters, including die shift, rotation, height, tilt, and warpage



Die warpage can be intuitively represented in 3D by mapping bump heights, which can also be used to flag non-wet defects.

X200 Specifications

Physical Parameters	Operating Parameters	Facilities Requirements
Tool Dimensions (WxLxH): 2.06 m x 2.85 m x 2.19 m	X-ray Source: Tungsten target, 1000 W, 14 mA, 70 kV	Electrical: 208 V AC (3-phase)/5-wire/8 AWG
Load Height: 0.957 m above floor	Detector: 30 MP, 16-bit, 18 mm x 12 mm FOV @ 2.8 µm pixel	AC Frequency: 50–60 Hz
Tool Weight: 6,300 kg	Substrates: 200/300 mm wafers, film frame, strips (with/ without boat cassette carrier), singulated parts	AC Current: 22/40 A (load/main circuit breaker)
Cleanroom FFU: ULPA filters @ 0.12 µm	Substrate Size (Max): 380 mm x 380 mm, thickness <5 mm	CDA: 90–140 PSIG (filtered 0.25 µm, 5 CFM minimum, 10 mm tube)
Compliance: S2, S8, S14, and NFPA79	Substrate Bow/Warp: <3 mm center-to-edge	Vacuum: 18–22 in-Hg (1 CFM, 10 mm tube)
Tool Frame: Steel	Substrate Weight (Max): <2.2 kg	Heat Exhaust: 8 in exhaust (2 pl), 2000 CFM total
X-ray Shielding: All exterior surfaces, FDA approved	Substrate Load Modules (sold separately): EFEM, strip handler	Ambient Humidity: 8-90% (non-condensing)
Safety Interlocks: All hinged doors electronically locked, interlocked switches, EMO	Automation: SECS/GEM, GEM300	Ambient Operating Temperature: 55–88°F

Bruker's Industry-Best Service and Support

Bruker is a metrology solutions expert with a deep experience with semiconductor fabrication plants. We actively leverage our semiconductor fab experience to develop solutions that meet the evolving needs of mass-production environments. We know that down-time and excursions are costly, so maximizing up-time is at the core of how our tools are designed and how our service and support operates.

Bruker has a long tradition of partnering with our customers to solve real-world application issues. After developing next-generation technologies with industry leaders and assisting customers in selecting the right system and accessories, this partnership continues through training and extended service long after the tools are sold. Our highly trained and certified team of support engineers, application scientists, and subject-matter experts are wholly dedicated to maximizing your productivity.

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