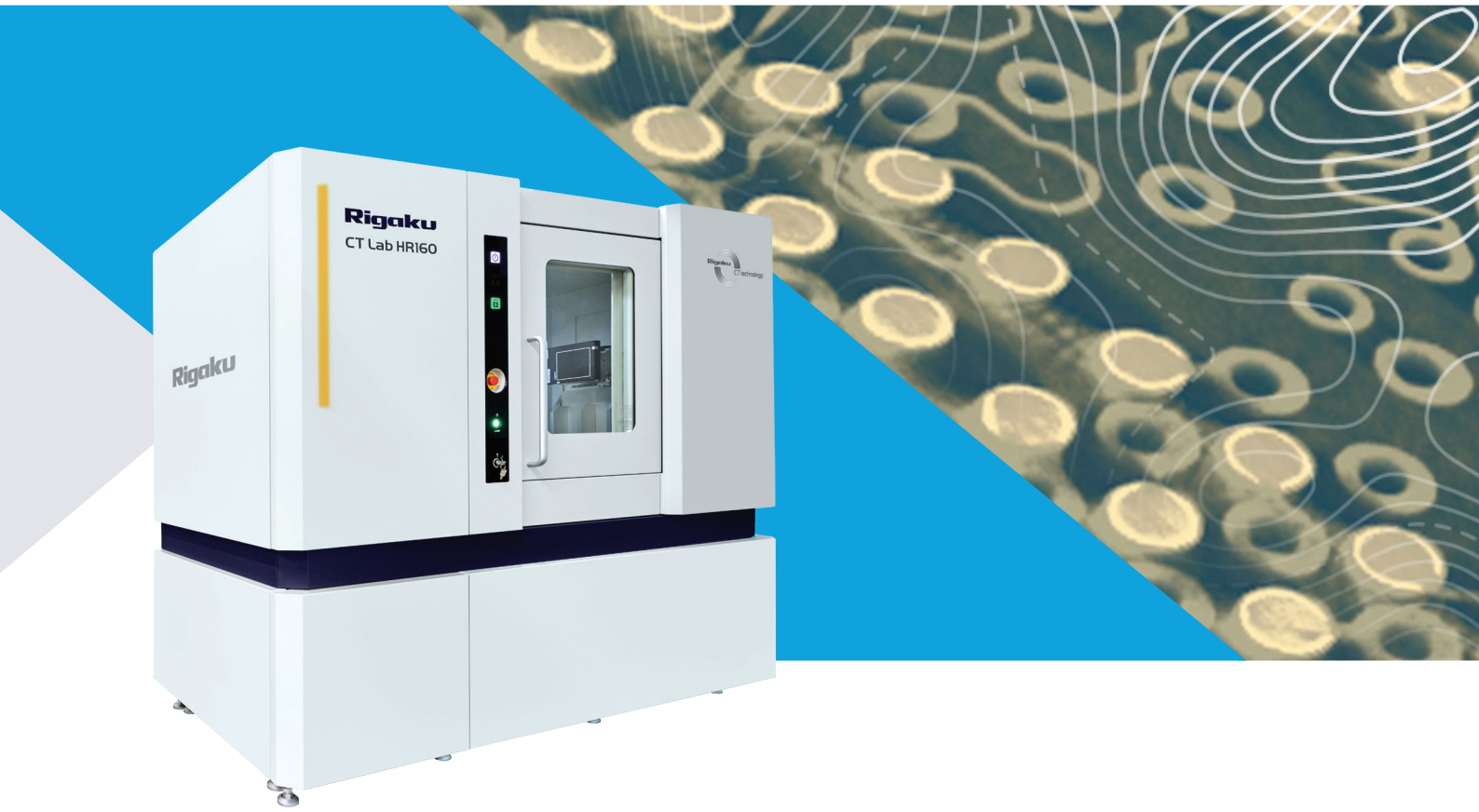
# CT Lab HR160

160 kV. Submicron details. One simple CT system.




Rigaku CT Lab HR160 — uncompromising high-resolution CT, now within reach for every lab.

Rigaku

POWERING NEW PERSPECTIVES

# CT Lab HR160

CT Lab HR160 offers you a simpler path to 160 kV submicron CT for research, process development, and design engineering, so you can reveal internal structures with 250 nm true spatial resolution without complex workflows or hardware reconfiguration.


Spatial resolution
**250 nm**

Maximum voltage
**160 kV**

FOV/ resolution
**No hardware reconfiguration**

## Easy to configure and easy to use

Different samples require different field-of-view (FOV) and resolution settings. CT Lab HR160 uses a simple lens-free cone-beam geometry, enabling seamless FOV and resolution adjustments without hardware reconfiguration. You can get the results and insights you need easily and quickly.

## Simpler scan workflow

CT workflow involves optimizing scan conditions, collecting projection images, and reconstructing the 3D volume. The number of steps and parameters to optimize can be overwhelming. CT Lab HR160 supports simple one-flow-bar software that guides you through the workflow, eliminating complexity and minimizing trial and error. You can obtain high-resolution scans easily and focus on analyzing the results.

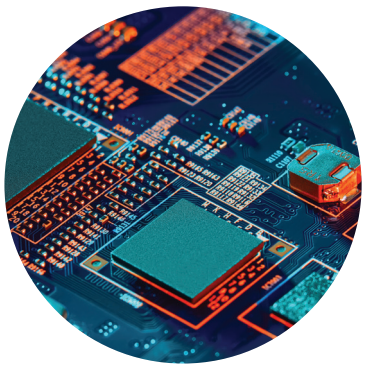
## 160 kV versatility and true submicron resolution within reach

High-end CT scanners are often built to support specialized measurement techniques and complex configurations, which can drive up cost and complicate workflow. CT Lab HR160 focuses investment where it matters most for research and engineering: 160 kV X-ray versatility, true 250 nm spatial resolution with 62 nm minimum voxel size, without the cost and operational burden that comes with specialized configurations.

# With true 250 nm spatial resolution, submicron X-ray CT reveals fine internal structures across materials and devices.

## Batteries

High-resolution X-ray CT visualizes fine pores, cracks, and material inhomogeneity within and between battery electrode particles non-destructively. By distinguishing interparticle and intraparticle defects in 3D, you can better understand how manufacturing quality and cycling-induced degradation affect capacity retention, reliability, and battery lifetime.

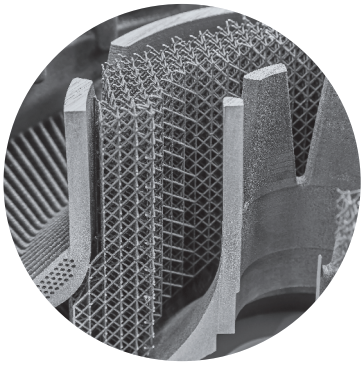


## Electronics

You can identify defects such as voids and thinning or broken connections in printed circuit boards (PCBs) and small devices, such as multilayer ceramic capacitors (MLCCs), non-destructively, allowing detailed investigation while keeping the devices' function intact.

## Academic Materials

Various advanced materials, such as composites, resins, polymers, and injection molding, can be inspected non-destructively to reveal voids, cracks, delamination, porosity, fiber misalignment, and weak interfaces in 3D to help connect material structure, processing, and damage to performance.



## Additive Manufacturing

Defects in additively manufactured parts include cracks and voids, including those inside the feedstock powders, and they are often complex. High-resolution X-ray CT reveals these internal features non-destructively in submicron detail, helping you understand defect formation and improve process control.

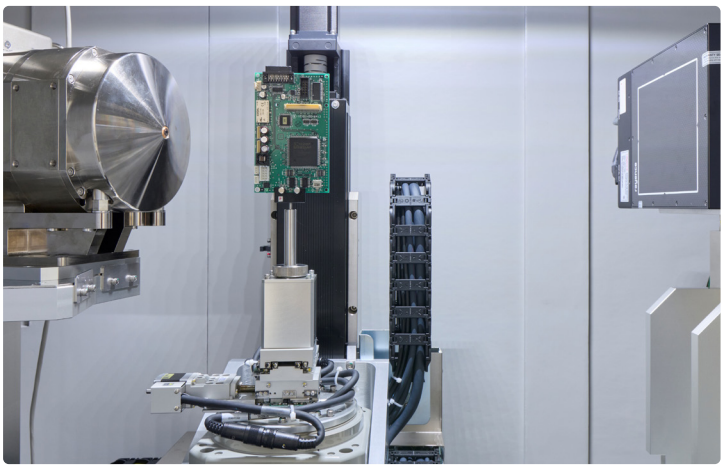
## Medical

Medical devices such as stents and implants can be studied non-destructively to visualize internal structure, function, and failure mechanisms. Submicron X-ray CT can also reveal fine structures in pharmaceutical tablets and particles, providing insight into dissolution behavior, coatings, pores, and internal defects.

# Reasons to choose the CT Lab HR160

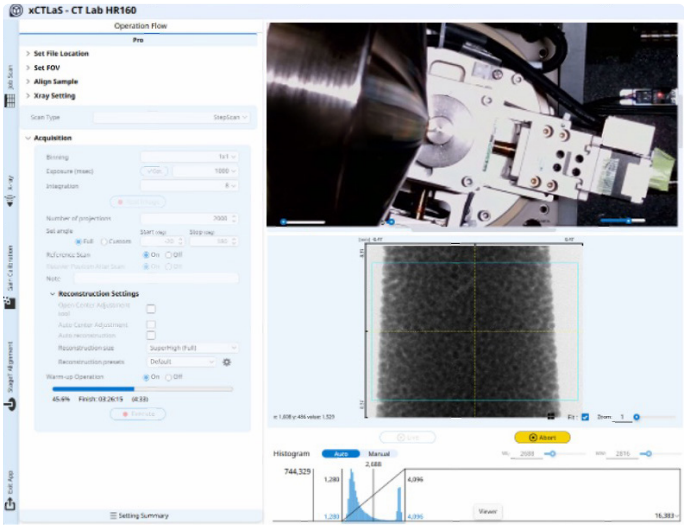
## Easy to use

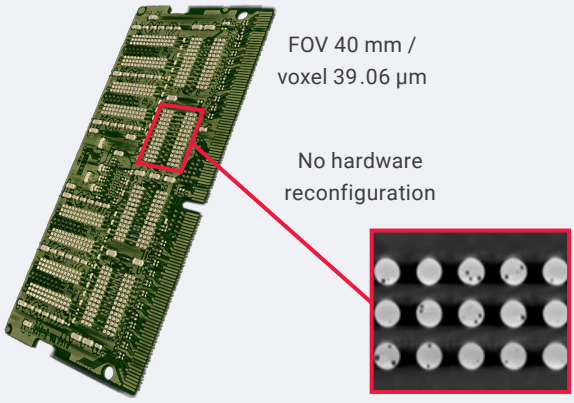
Scan setup is easy because all you need to adjust is the source-to-detector distance (SDD) and source-to-object distance (SOD) to optimize FOV and resolution. Beyond that, there is **no hardware to reconfigure.** CT Lab HR160 uses a single nanofocus X-ray source, lens-free cone-beam geometry, and a simple system architecture that avoids the complexity of multi-source, multi-detector, or multi-lens systems.



## Simple

You can move from sample setup to scan acquisition, reconstruction, and viewing results in a streamlined workflow. The CT Lab HR160 software provides a **simple one-flow-bar** interface for configuring and running scans, while also supporting CT reconstruction and result visualization. Reconstruction can be performed automatically, with reconstructed volumes loaded directly into the CT Viewer for immediate review.



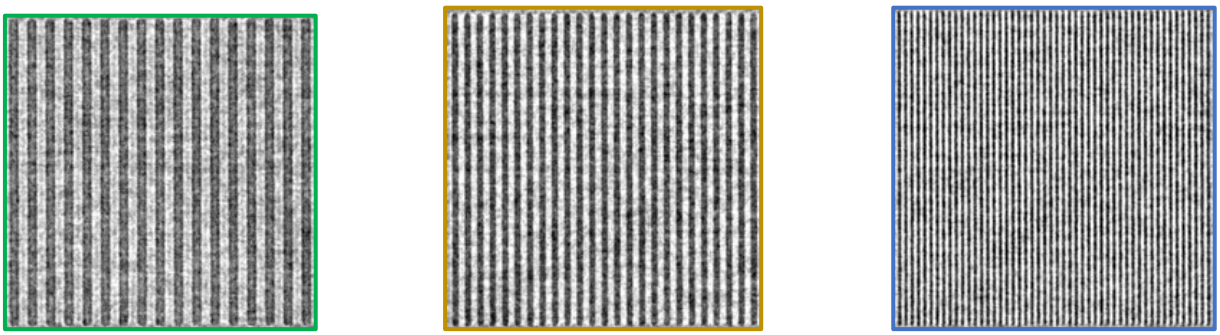

## Versatile

You can inspect samples consisting of a wide range of materials, from organic materials to electronics, because CT Lab HR160 combines submicron imaging with a wide range of **40–160 kV** X-ray voltage and a 16.6 W **nanofocus transmission** X-ray source with **flexible cone-beam geometry.**

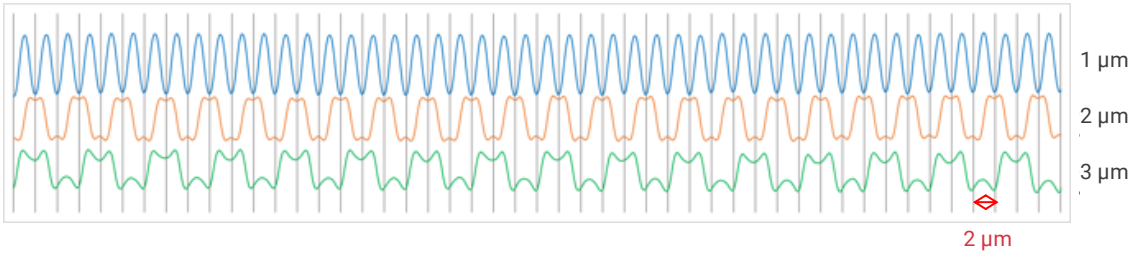
# High resolution

You can reveal fine internal structures in 3D because CT Lab HR160 delivers **true 250 nm spatial resolution and 62 nm minimum voxel size,** supported by a nanofocus X-ray source, high-resolution CMOS detector, long 800 mm maximum SDD, below 100 nm spot stability, and below 100 nm rotation stage radial error.

**QRM Micro-CT Bar Pattern Phantoms NANO**



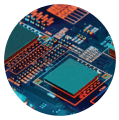
3 µm line pairs | 2 µm line pairs | 1 µm line pairs




# Affordable

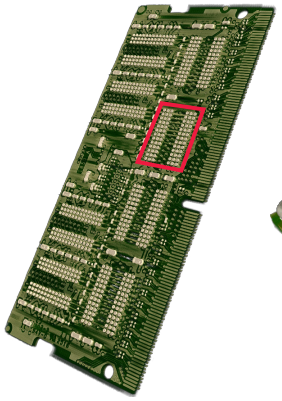
You can get the 160 kV capability and true submicron resolution needed for research, process development, and design engineering without paying for specialized configurations you may not need, because CT Lab HR160 focuses investment on the core technologies required for practical high-resolution CT.

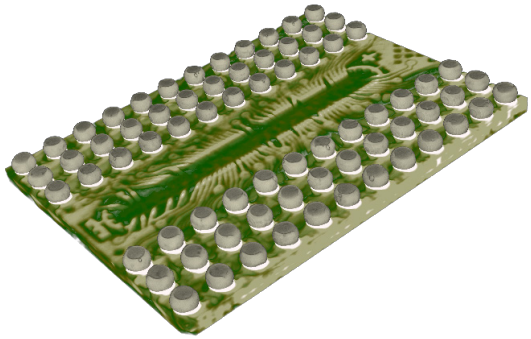
# Get the big picture and the fine details easily



## Analyzing internal structures and defects of electronic components

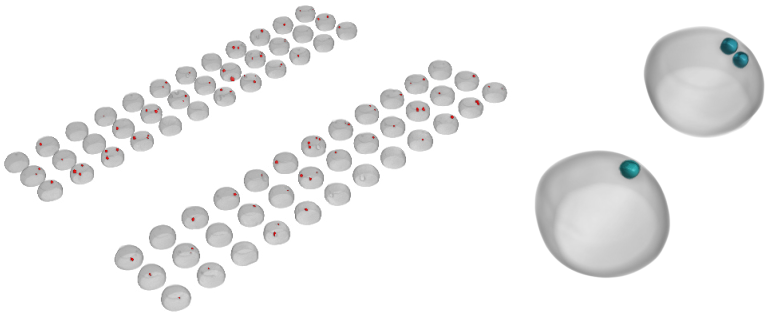
X-ray CT allows you to visualize the internal structure of printed circuit boards (PCBs) and small electronic components in three dimensions, including solder joints, wire connections, electrode layers, voids, cracks, and dimensional variations. Because CT can inspect selected regions without physical cross-sectioning, it is especially useful for investigating buried features, such as voids in solder joints.



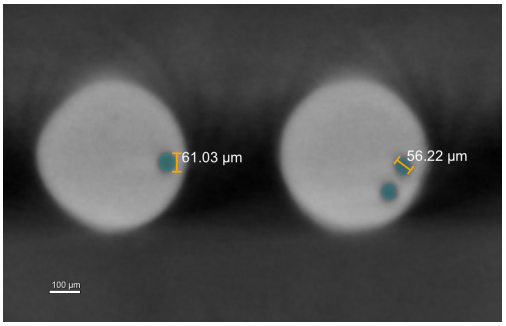


## RAM stick

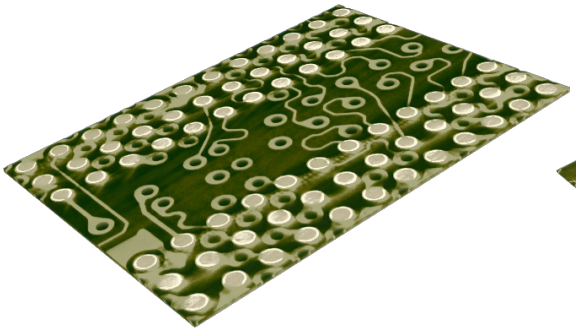
Starting from the entire RAM stick scan, you can zoom into the areas of interest to analyze solder joint defects down to a few microns in size, wire connections, and IC layer integrity.

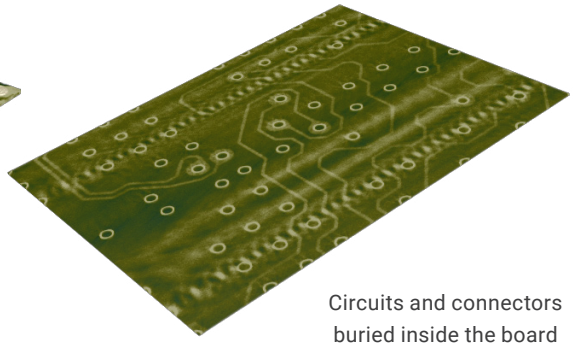


Solder joints with pores highlighted in red



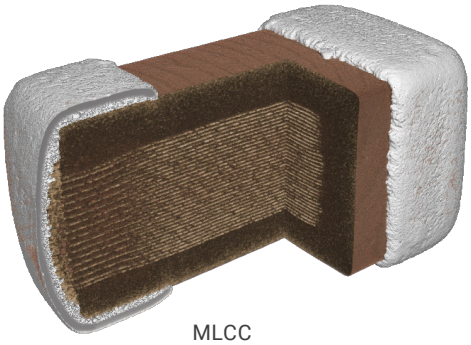

Solder joints containing pores





Circuits and connectors buried inside the board

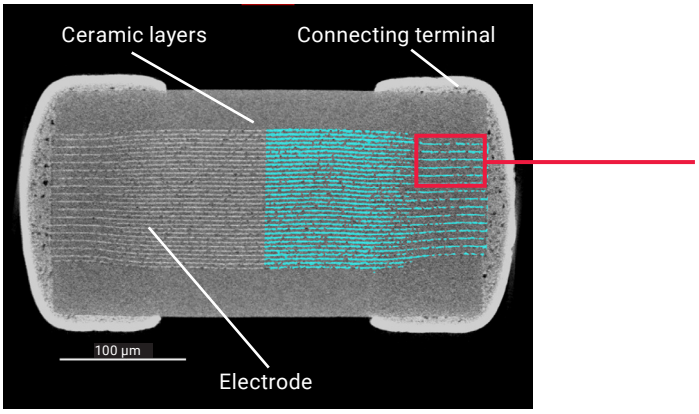
With submicron imaging capability, CT Lab HR160 helps engineers examine fine internal structures that may influence electrical performance, reliability, and failure mechanisms, such as electrodes' spacing inside multilayer ceramic capacitors (MLCCs) or pore distribution and thickness variance of electrodes inside inductors.



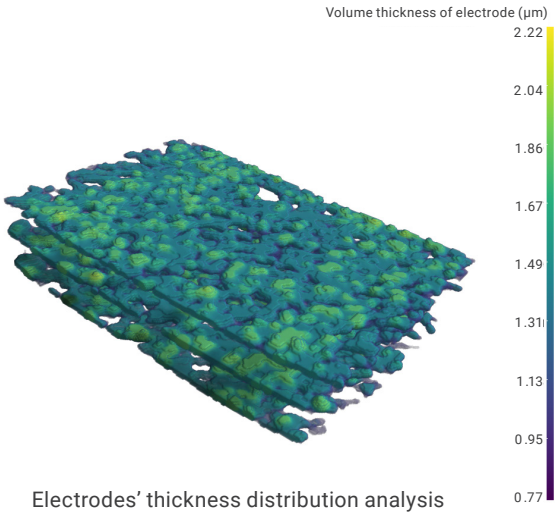
MLCC

## Multilayer ceramic capacitors (MLCCs)

The electrodes' thickness and spacing, as well as void distribution, can be investigated with submicron resolution.



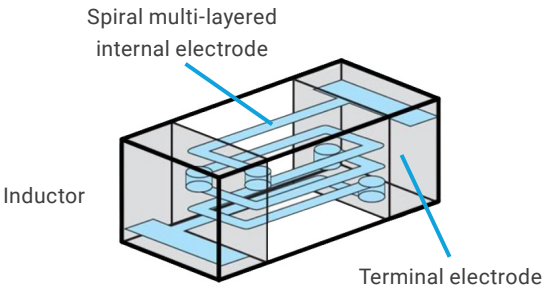

Cross-section of MLCC

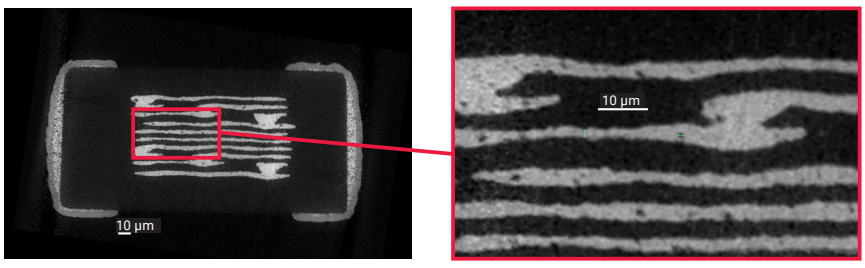



Electrodes' thickness distribution analysis

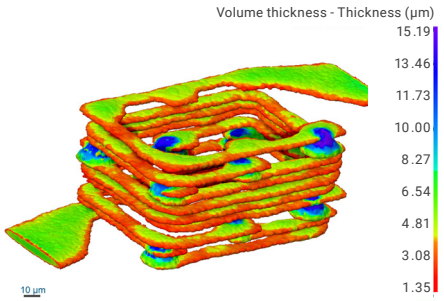
## Inductor

Internal electrode thinning, voids, and discontinuities can be visualized in 3D. These structural variations may increase local resistance, contribute to localized heating, and reduce the mechanical integrity and reliability of the inductor.




Cross-section shows thinning of the internal electrode and voids

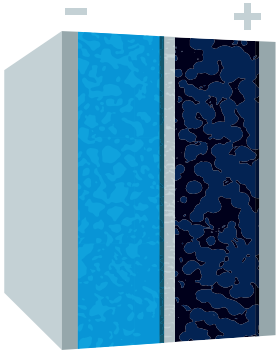



Electrode thickness distribution analysis visualizing thin (red) parts

# Never miss hidden voids and cracks

## Analyzing degradation mechanisms in battery materials

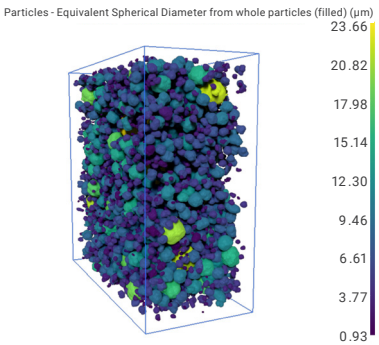
High-resolution X-ray CT allows you to visualize pores, cracks, and material inhomogeneity within and between cathode and anode particles in three dimensions. By distinguishing interparticle from intraparticle cracking and quantifying their distribution non-destructively, you can investigate how manufacturing quality and cycling-induced degradation affect lithium-ion transport, mechanical stability, capacity retention, and battery lifetime.



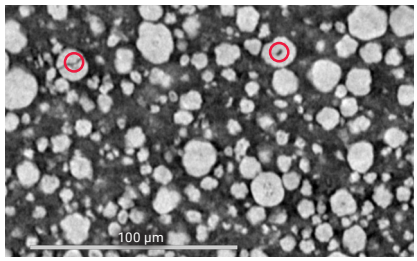
Lithium-Ion Battery

## Li-ion battery pouch cell

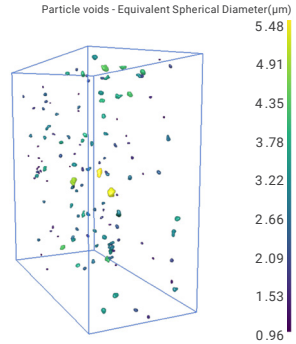
CT Lab HR160 reveals sub-2 µm voids within cathode particles that may be poorly resolved or missed by conventional micron-resolution CT. In this example, roughly 40% of the segmented voids are smaller than 2 µm, highlighting the need for true submicron imaging to accurately quantify particle-level porosity.




Particles were segmented and separated to calculate the particle size distribution



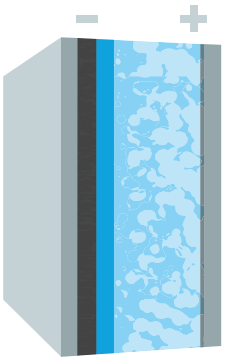

Cracks and voids in cathode particles



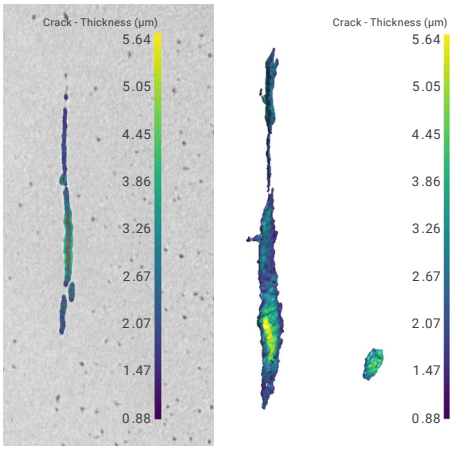

Voids within particles were segmented to calculate the void size distribution

## Solid-state battery device

In solid-state batteries, even low levels of cracking can be significant during cycling, as cracks may propagate and contribute to capacity fade, reduced reliability, and shorter battery lifetime. CT Lab HR160 can resolve such interparticle and intraparticle cracking non-destructively in three dimensions, helping distinguish between cracking in electrode layers and cracking inside electrode particles.



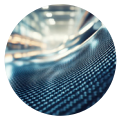
All Solid-State Battery




Crack in the solid electrode

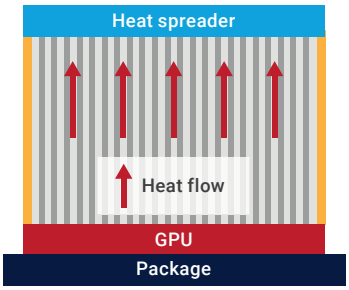
Sample: Courtesy of University of Hyogo
T. Nakamura, T. Kakibe, S. Takahashi, *Solid State Ionics*. 417 (2024) 116685.

# Visualize advanced structures in 3D



## Revealing defects and interfaces in advanced materials with true submicron X-ray CT

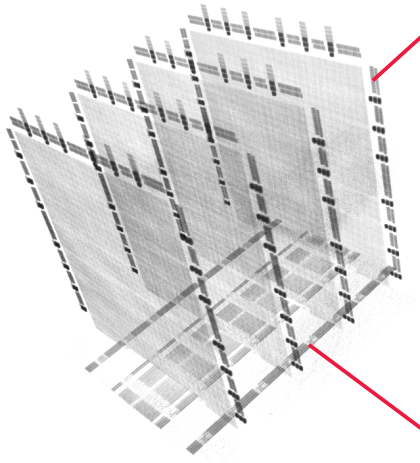
X-ray CT allows you to visualize fine internal structures in advanced materials in three dimensions, including voids, cracks, porosity, fiber orientation, delamination, adhesive bonds, and material interfaces. By inspecting these structures non-destructively, you can better understand how processing, internal defects, and microstructure affect strength, reliability, and long-term material performance while keeping the sample intact.

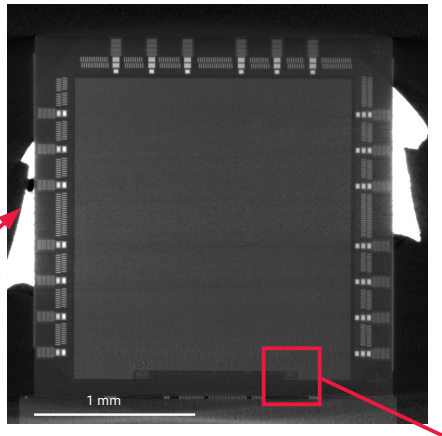



MOSAIC cube-on GPU

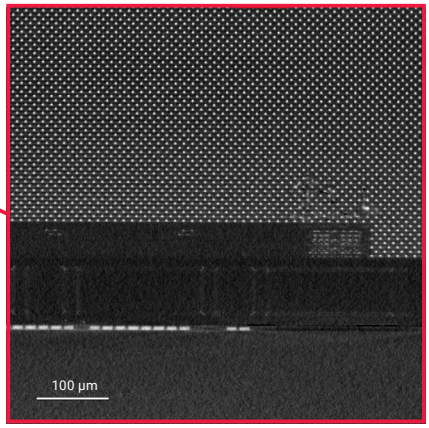
### Mosaic cube

Submicron X-ray CT reveals the stacked architecture of a mosaic cube package in three dimensions, including individual chip layers and the bottom logic die connection. The high-resolution 3D data allows dimensional analysis without disassembling the device, providing precise structure alignment verification on chip stacking quality.

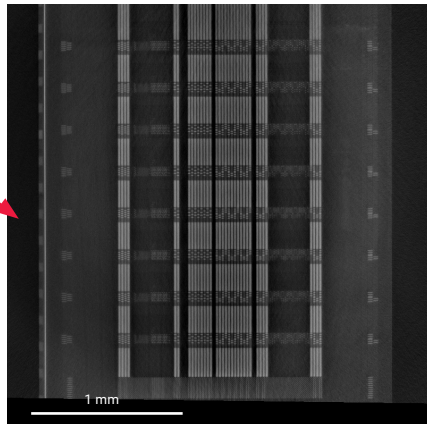





One chip layer



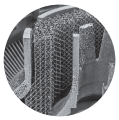

Dimension analysis of a chip layer and bottom logic die connection




Bottom GPU connection

Sample: Courtesy of The University of Tokyo

# Studying cracks, pores, and surface roughness of additively manufactured objects

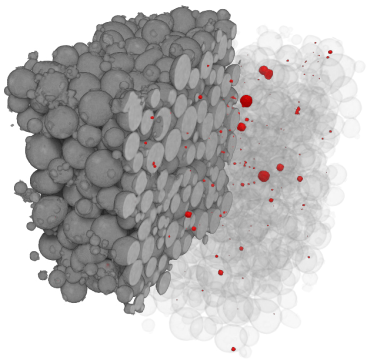


## CT analysis of Additive Manufacturing (AM) samples

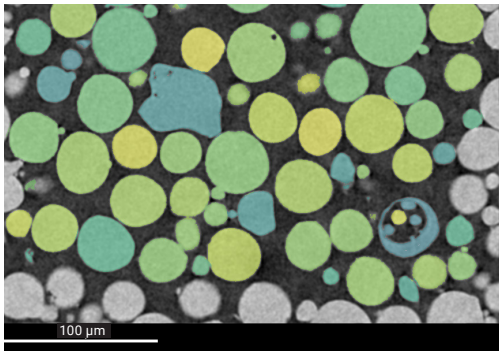
X-ray CT plays a vital role in the quality assurance, process optimization, and failure analysis of additively manufactured parts. You can visualize cracks and pores non-destructively and analyze their sizes, shapes, and spatial distribution quantitatively. The submicron resolution can also reveal micro-pores inside feedstock powders, helping distinguish the pores introduced during the fabrication process and the ones inherited from the feedstock.

## Ti6Al4V AM feedstock

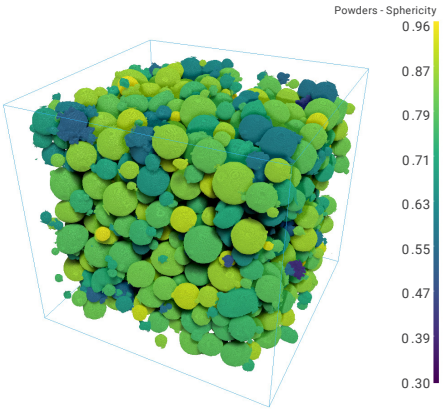
CT images of Ti6Al4V feedstock powder revealed irregularities and pores in individual powder particles. These pores can remain in the manufactured parts and compromise their integrity when the powders are not completely melted during the fabrication process.



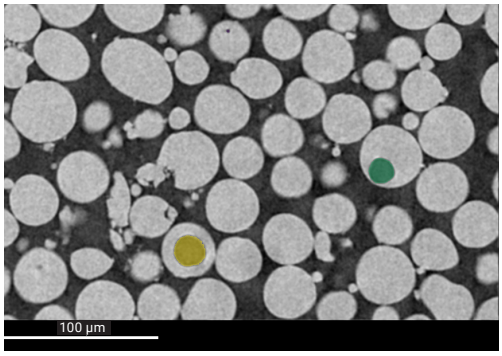
Pores inside powder particles are highlighted in red



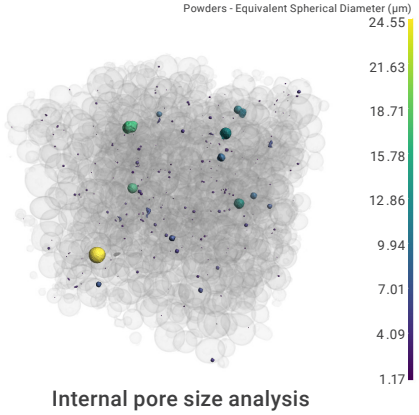

Irregular/faulty powder




Powder particle sphericity analysis




Cross-sections of feedstock powder image




Internal pore size analysis

# Ultimate peace of mind

## Don’t worry about maintaining the X-ray source performance

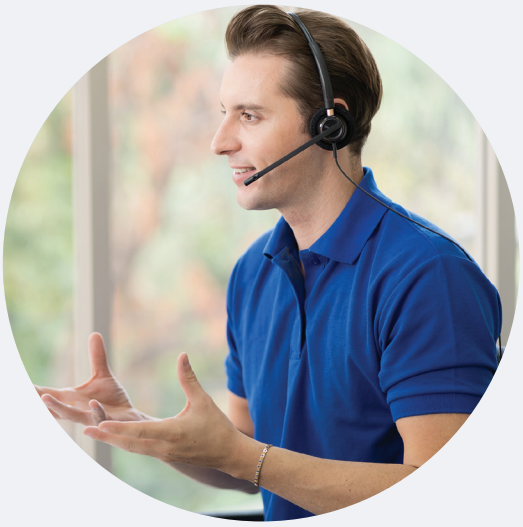
High-resolution CT does not need to come with extensive training or a complex workflow. CT Lab HR160 is designed to give you true submicron imaging and 160 kV capability without the added burden of frequent hardware changes, complex alignment, or advanced configurations you may not need.

Its simpler configuration also makes day-to-day use easier to manage. New users can be onboarded more efficiently, experienced users can move faster from setup to results, and your team can spend less time managing the instrument and more time answering research, process, and design questions.

## Don’t worry about complex data analysis

**Lifetime application support**

No matter how clear the CT images you obtain from your scanner are, the interpretation of CT data and qualification of scanned products are not always straightforward. Without proper optimization, data analysis alone can take a long time while you need the results fast. All CT Lab HR160s come with in-person training at your facility to ensure you are comfortable with collecting data and analyzing your own samples. Our experts will continue to provide technical support to help you set up your inspection procedures for the lifetime of your CT Lab HR160.



# Specifications

| Overall performance | |
|---|---|
| Field of view (FOV) | Min. 0.18 mm φ × 0.14 mm tall/scan<br>Max. 103 mm φ × 81 mm tall/scan |
| Minimum voxel size | 62 nm |
| Best spatial resolution | 250 nm @ 300 nm focus size |
| Scan modes | Standard, stitched, half |

| Detector | |
|---|---|
| Detector type | CMOS |
| Active area | 116.4 mm × 145.7 mm |
| Pixel count | 2352 × 2944 pixels |
| Pixel size | 49.5 × 49.5 µm |
| Dynamic range | 14-bit |

| X-ray source | |
|---|---|
| Maximum power | 16.6 W |
| Applied voltage | 40-160 kV |
| Focus size | 0.3 – 2.0 µm |
| Target material | W |
| Tube type | Transmission, open |
| Cooling | Water cooled , included |

| Geometry and sample holder | |
|---|---|
| Source-to-object distance (SOD) | 1.0 – 584 mm |
| Source-to-detector distance (SDD) | 200 – 800 mm |
| Maximum sample/object size | φ250 mm × H450 mm (XYZ = 0; no travel)<br>φ200 mm × H200 mm (full XYZ travel) |
| Maximum sample/object weight | 10 kg |
| Sample rotation | -180 - 540° |

Door opening 40 W × 55 H cm


**Total weight:**
1850 kg (including the CT system, X-ray generator unit, and radiation shield)

**Required power supply:**
Required power: 1 φ, AC 200 –240 V ±10 %,
50/60 Hz ±1 % [15 A], 2000 VA
Computer: 1 φ, AC 100 –240 V ±10 %,
50/60 Hz ±1 % [15 A], 1500 VA

**Gas requirement:**
Dry gas (Air, $N_2$), 0.6 –1.0 Mpa, ≥ 11.6 NL/min

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