Four Dimensional X-Ray Microscopy

ZEISS Xradia 520 Versa

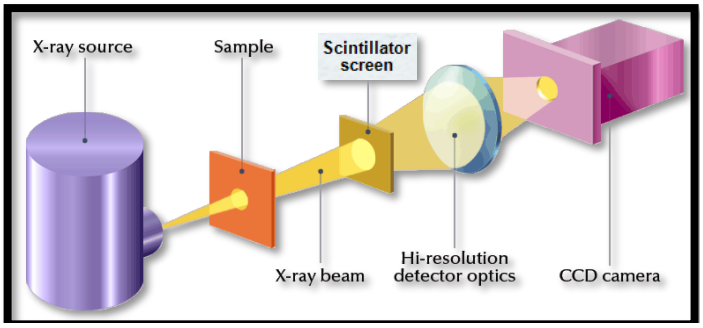
Four Dimensional X-ray Microscopy (FDXM) is an advanced X-ray microscopy facility to look at three dimensional (3D) internal structure of samples and its evolution. This constitutes of Zeiss Xradia 520 Versa x-ray tomography system along with other attachments of high temperature and low temperature tensile stage (Deben CT5000-TEC). The facility gets its name as four dimensional microscopy because it has three spatial dimensions and one time dimension (produced by stresses and temperature imparted by the Deben stage).

How FDXM Works

- In FDXM, the sample is imaged from different directions, ideally across an angular range of at least 180°.
- A single image at one particular angle is called a projection.
- Computer algorithms can be used to reconstruct the internal, 3-dimensional (3D) structure of the sample from a series of projections.
- The reconstructed volume can be visualized in different ways; for example slice by slice (also referred to as virtual cross-sectioning), or by rendering a 3D view of individual internal features.

Benefits

- Non-destructive interior tomography uniquely enabled by Scout-and-Zoom
- True spatial resolution of 700 nm
- Minimum achievable voxel of 70 nm
- Two-stage magnification that provides resolution at a distance (RaaD), delivering large, flexible working distances while maintaining submicron resolution



Objectives and pixel resolution at bin 2

- 0.4X : 5-55um
- 4X : 0.7-5um
- 20X: 0.5-0.9um
- 40X: 0.3-0.5um
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Advanced features

- **Vertical stitching**

Stitching increases scan volume vertically, allowing to image and analyze larger volumes. This technique allows to combine multiple datasets which have an offset in vertical direction.

- **Scout and zoom**

This is a unique capability allows to perform a “Scout” scan of low resolution to identify interior regions for higher resolution “Zoom” scans.

- **Phase contrast**

This technique is typically used for low-Z materials such as biological specimen or polymer materials where there is a distinct difference in refractive indices between regions. It is most advantageous on smaller samples since high magnification objectives can be used to enhance the quality of phase contrast and limit the possible noise of images.

- **High-Aspect Ratio Tomography (HART)**

The innovative High Aspect Ratio Tomography (HART) mode on FDXM provides you with higher throughput imaging for flat samples such as those found with semiconductor packages and boards.

- **In Situ interface**

X-ray imaging is uniquely suited to image materials under variable environments with controlled conditions including over time (4D) to non-destructively characterize and quantify the evolution of 3D microstructures with compression and thermal stages.

Applications in a wide range of fields:

- **Materials Research**

Characterize materials, observe fracture mechanics, investigate properties at multiple length scales, quantify and characterize microstructural evolution.

- **Natural Resources /Geology**

Characterize and quantify pore structures, measure fluid flow, study carbon sequestration processes, analyze tailings to maximize mining efforts.

- **Life Sciences**

Perform virtual histology, visualize cellular and subcellular features, and characterize submicron structures in samples that are inches to centimeters in size.

- **Electronics**

FDXM offers Non-destructive submicron imaging of intact packages for defect re-localization and characterization that helps to optimize the process development, study package reliability, perform failure analysis, and analyze package construction.

- **Pharmaceuticals**

Enables to measure the thickness and uniformity of coatings applied to tablets and capsules. With FDXM, one can visualize the distribution of ingredients in the final dosage, characterize foreign material based on density, shape or size, detection of anomalies in formulations. High contrast tomography helps in establishing correlations between coating density, drug product performance and product expiry.

- **Additive manufacturing**

Enables high-resolution, non-destructive imaging for microstructural analysis of Additive Manufacturing (AM) parts and in detail inspection of shape, size, and volume distribution analysis of particles in AM powder bed to determine the process parameters.

Application in different industrial sectors:

- Pharmaceuticals
- Oil and gas exploration
- Biological internal structure Analysis
- Bio implants
- Internal structure of manufactured Component analysis

For Details

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