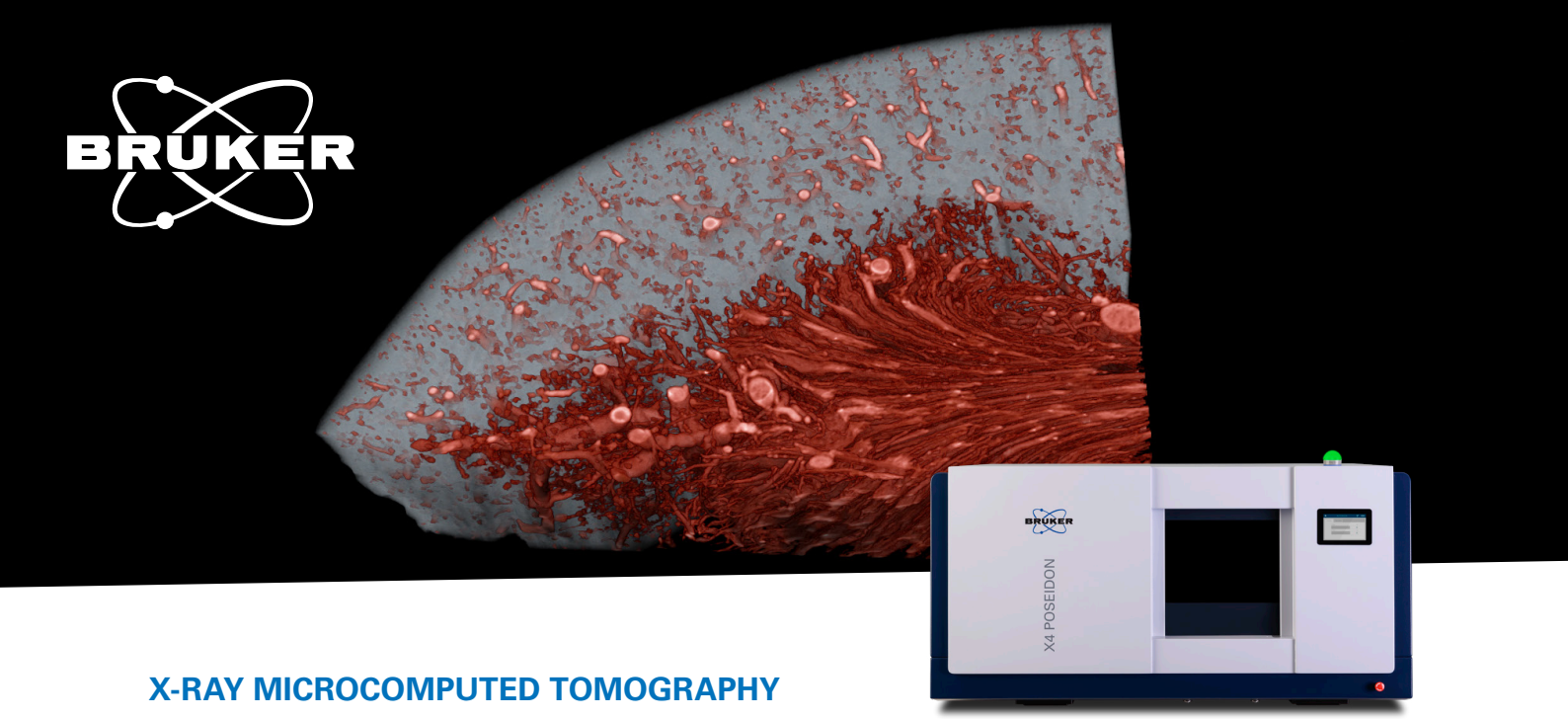

X-RAY MICROCOMPUTED TOMOGRAPHY

X4 POSEIDON - Kidney

Innovation with Integrity

MicroCT or micro-computed tomography is a game-changer for researchers across various fields. It provides high-resolution, 3D datasets that allow for detailed visualization of internal and external structures without destroying the sample. Additionally, the ability to visualize fine details aids in the identification of defects, anomalies, and structural integrity, which is crucial for research and innovation. This non-destructive technique can be a valuable asset for studying the morphology and microarchitecture of for example biological tissues, such as the kidney.

Most research with microCT on kidneys focuses on vascular imaging and morphometry. This includes detailed studies of the kidney's blood vessels and glomeruli, which are crucial for understanding kidney function and disease. In addition, it is also used to study various kidney disease models, including genetic models like eNOS-/- mice, which show significant vascular defects.

The versatility and flexibility of the X4 POSEIDON are key aspects that support research in obtaining more information on their samples. GEM plus (geometrical magnification) allows for high resolution acquisition at shorter distances, optimizing scan time without compromising on resolution. The configurability of this system ensures the best set-up for the applications of interest. Additionally, the software to visualize, analyze and create comprehensive data is included in Bruker's 3D.Suite package, supporting the most pressing needs in research.

Scan parameters

- Detector:
  7 MP Flat Panel (15 µm scan)
  16 MP sCMOS (2.5 µm scan)
- Voxel size:
  15 µm (1x1 binning mode)
  2.5 µm (1x1 binning mode)
- Source:
  Transmission type
- Source settings:
  70 keV, 9.8 W (15 µm scan)
  50keV, 5 W (2.5 µm scan)
- Filter:
  0.5 mm Al (15 µm scan)
  No filter (2.5 µm scan)
- Rotation step:
  0.3° over 360° (15 µm scan)
  0.15° over 360° (2.5 µm scan)
- Scan time:
  27 minutes (15 µm scan)
  6 hours 26 minutes (2.5 µm scan)
- Phase retrieval (Paganin)
  reconstruction, β/δ ratio 100

Cover Image: a pseudo-colored 3D volume rendered image of a rabbit kidney with blood vessels contrasted, acquired at 15 um voxel size.

The fast scan time in combination with the low noise active pixel performance of the flat panel detector and GEM plus allow for fast acquisition of detailed structures.
This is visible in figure 1, which shows a Maximum Intensity Projection (MIP) of a part of the vasculature in the rabbit kidney.

To be able to truly visualize the blood vessels, the use of a contrast agent is necessary. This techniques is also called microangio-CT and has been developed for rapid and reliable acquisitions of vascularized tissues. Microangio-CT provides faster results compared to traditional histology-based approaches and reduces processing artifacts. Studies have shown its effectiveness in identifying changes in vascular structure and perfusion, particularly in disease models like diabetic nephropathy and hypertension.[1]

Reference

[1]Hlushchuk et al (2017) Am J Physiol Renal Physiol 314: F493–F499

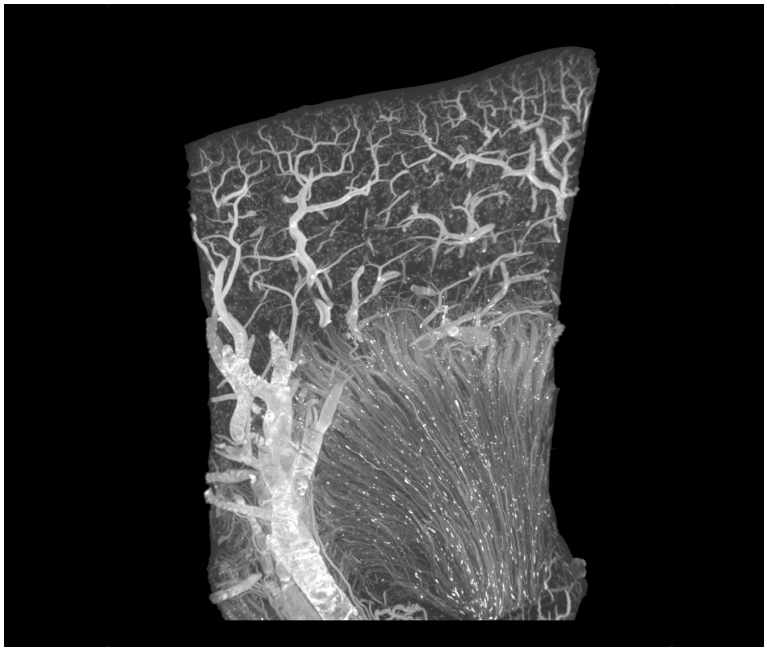

Figure 1: MIP image of the vasculature of a part of the rabbit kidney, acquired at 15 µm voxel size. The vasa recta in the medulla form a striking fan-like structure, visible in the lower part of the image.

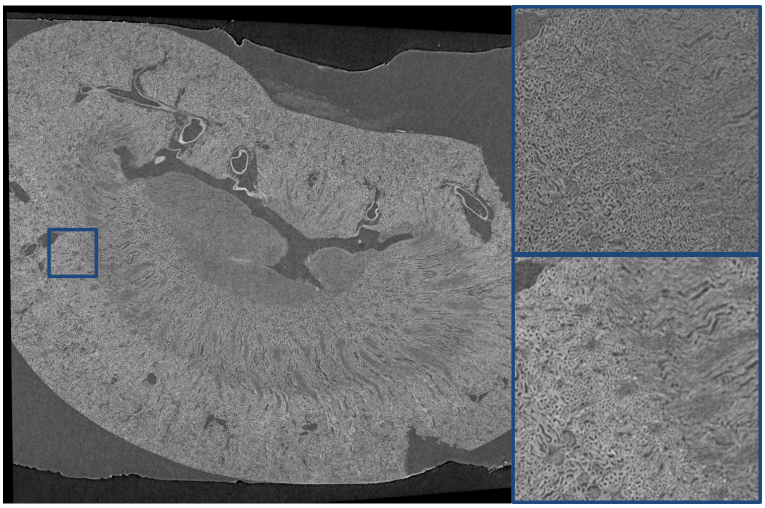

Figure 2: phase retrieval cross-section of a mouse kidney imbedded in parafilm (left), acquired at 2.5 µm voxel size; zoomed in cross-section of the absorption reconstruction (top right) and PR reconstruction (bottom right), obtained from the same acquisition.

The sCMOS detector in the X4 POSEIDON excels at imaging fine details of soft tissues, such as the mouse kidney (Figure 2). This paraffin embedded kidney was not stained, nor infiltrated for microangio-CT. The improved contrast is due to the phase retrieval (PR) process applied during reconstruction. The phase retrieval algorithm enhances the visibility of the cortex and medulla, tubule walls and glomeruli, making it possible to measure and count these small structures without the destruction of the sample.

These applications make microCT a powerful tool for advancing the understanding of kidney health and disease.

Bruker BioSpin
info@bruker.com

bruker.com

Worldwide Offices
bruker.com/

X4 POSEIDON
bruker.com/