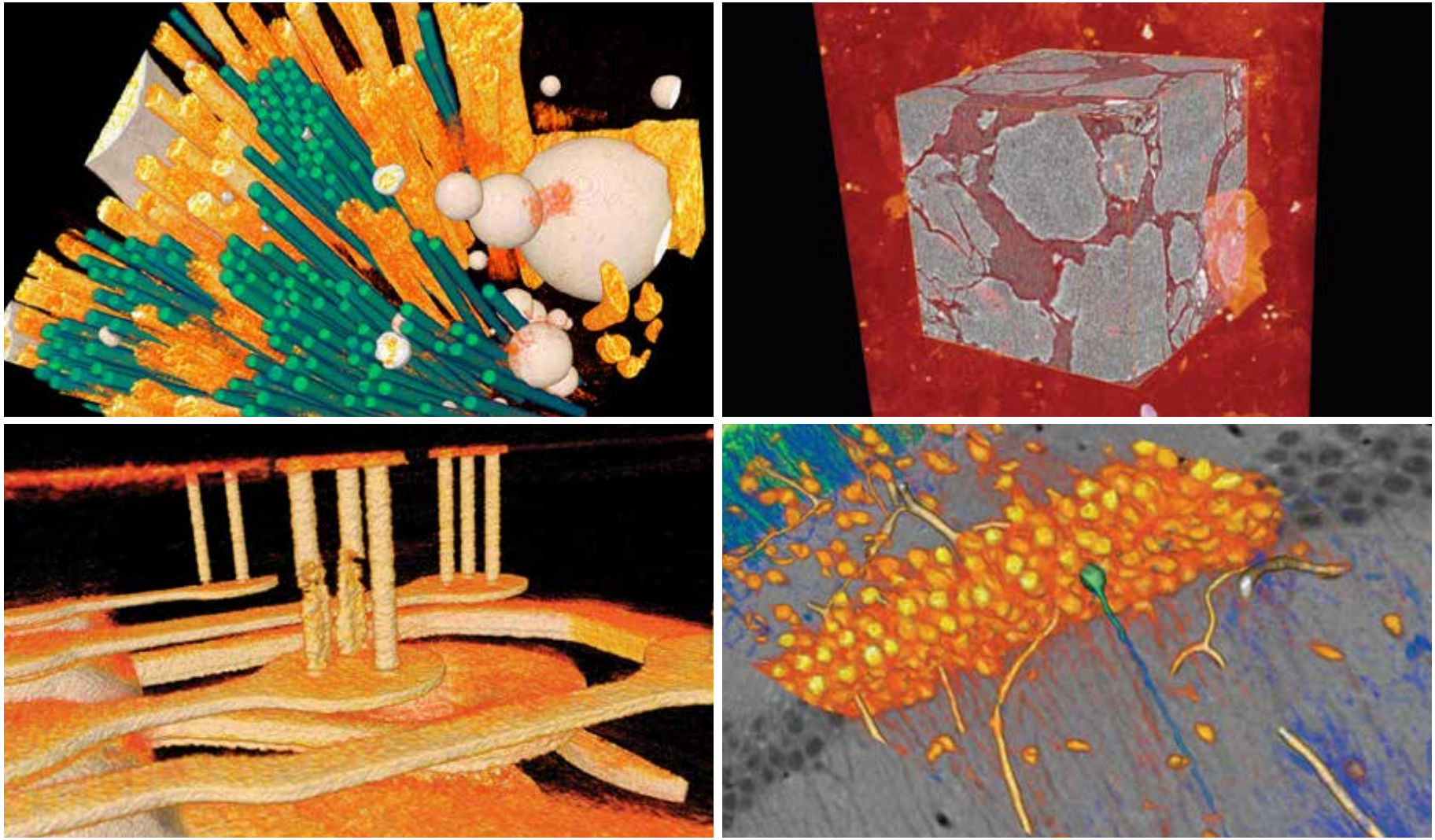


Imaging for Science and Innovation

High-resolution 3D X-ray Microscopy... *Beyond micro-CT*

ZEISS

We make it visible.

Innovative Imaging to Advance Science Microscopy and Industry

From research to industry, ZEISS Xradia 3D X-ray microscopy (XRM) solutions are uniquely architected to facilitate quantitative understanding of microstructure under both ambient and *in situ* environmental conditions without destroying the sample. This enables imaging and tomography of microstructures as well as micro- and nanostructural evolution under a variety of conditions.

Industry-leading resolution, from synchrotron to laboratory. Our synchrotron heritage enabled us to develop superior lab-based XRM. The Xradia Versa family, at true submicron spatial resolution 700 nm and minimum achievable voxel* size 70 nm, and the Xradia Ultra family at 50 nm resolution and 16 nm voxel* are a new caliber of 3D X-ray microscope. These systems offer a distinct set of unique technological advantages beyond the limits of conventional micro- and nano-CT.

Discover a New Dimension in 3D X-ray Microscopy

Xradia Versa RaaD™: Highest resolution at a distance enabled by a two-stage magnification architecture means that you don't have to compromise resolution for odd-shaped or large specimens. And, samples enclosed within *in situ* chambers can be imaged at resolutions unmatched by conventional micro-CT architectures.

Xradia Ultra: Reach into the nanoscale non-destructively with the only laboratory hard X-ray microscope that uses X-ray focusing optics to achieve 3D images with 50 nmspatial resolution. At these length scales, imaging in 3D over time enables 4D studies that can be correlated to downstream destructive techniques also found in the electron microscopy laboratory.

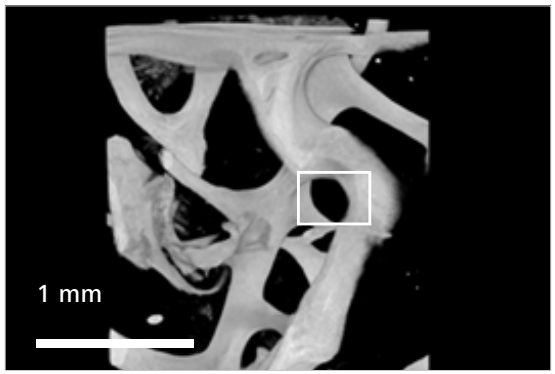
Highest absorption contrast and unique phase contrast enable unparalleled imaging quality, whether for soft materials such as unstained tissues or low-Z materials like carbon fibers and polymers, with the ability to differentiate between phases of similar density.

Multi-length scale imaging of the same sample across a wide range of magnifications – and from Xradia Versa to Xradia Ultra to other high resolution modalities – is possible with ZEISS XRM non-destructive imaging and capability for local tomography.

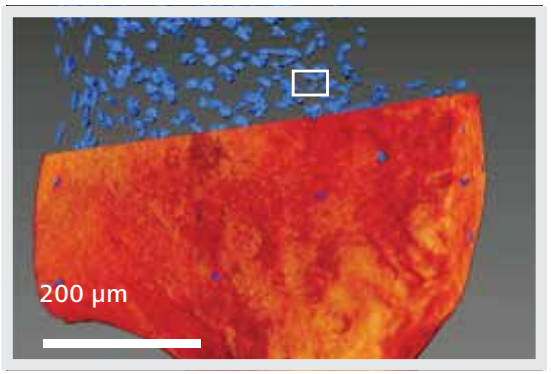
In situ and 4D (time dependent) studies for repeated measurement of the same sample across varying conditions – pressure, temperature, humidity, current, etc. – in ambient environments or in situ chambers, with high resolution even at large working distance.

X-ray vision enables 3D imaging of buried structures at high resolution without sample destruction, critical for intact electronics packaged devices and environmentally sensitive materials.

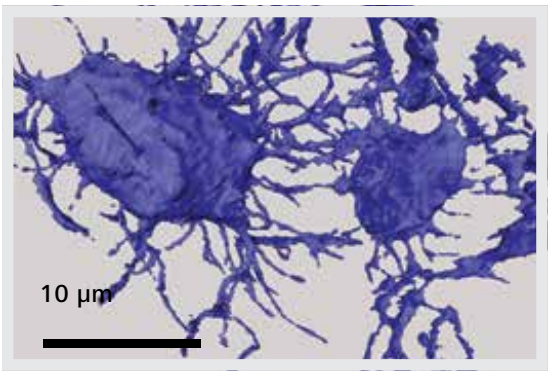
Multi-length Scale Imaging



Transilial bone biopsy



Trabecular node – segmented osteocyte lacunae

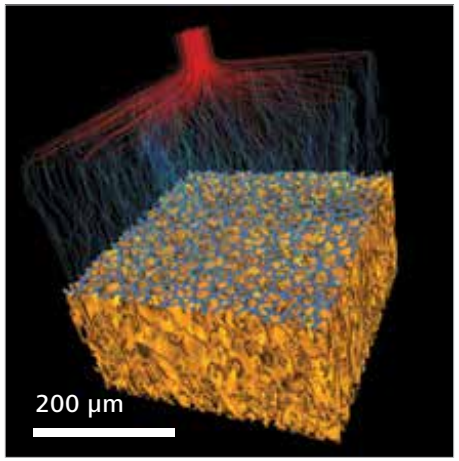


Osteocyte lacunar-canaliculi network

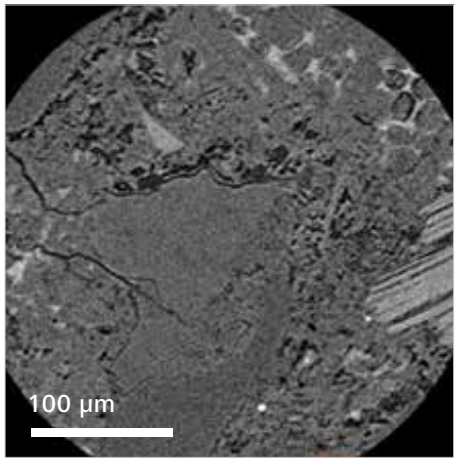
* Voxel (also referred to as "nominal resolution" or "detail detectability") is a geometric term that contributes to but does not equal resolution, and is provided here only for comparison.

ZEISS Xradia XRM specify on spatial resolution, the most meaningful measurement of an instrument's performance.

Technology & Solutions that Meet the Most Challenging Applications in Diverse Fields of Research & Engineering



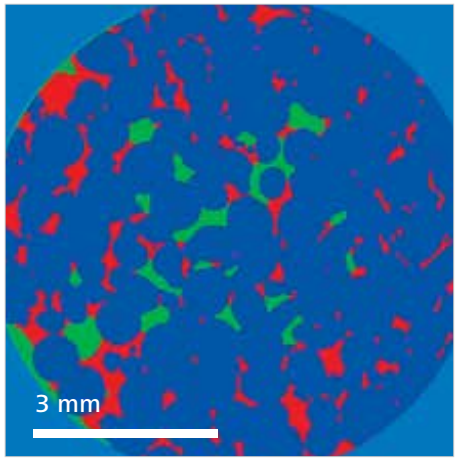
Porous Polymer



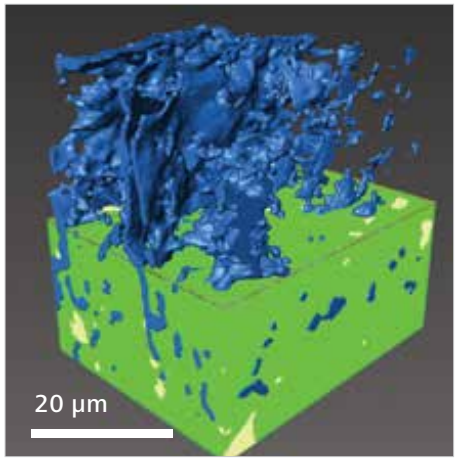
Concrete

Materials Science

ZEISS 3D X-ray microscopy solutions provide high resolution and high contrast imaging of internal structures to enable analysis (finite element modeling, porosity characterization, etc.) of a wide range of materials. Explore and quantify the evolution of microstructure non-destructively via 4D and *in situ* experiments at resolutions never achieved before in the laboratory.



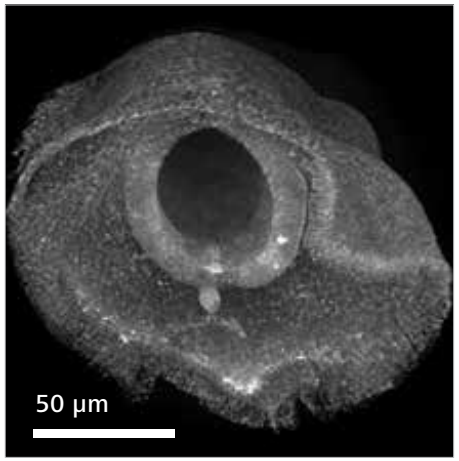
High resolution, high contrast image during multi-phase fluid (CO_2 and brine) flow



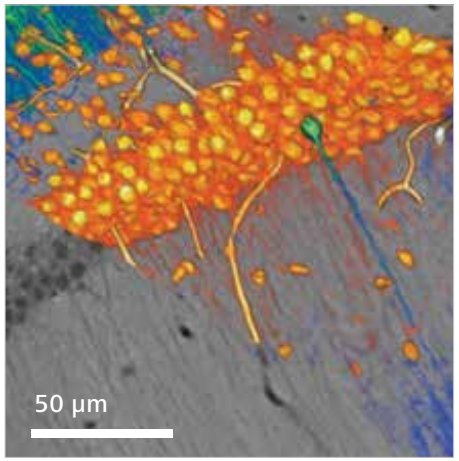
Micron-scale fracture network in shale

Natural Resources

From creation of digital rock models to imaging rock during fluid flow and geomechanics experiments, ZEISS provides the highest resolution and contrast for detailed petroleum rock characterization ofcarbonates, shale, and complex sandstones. These core capabilities also enable 3D mineralogy studies in mining that include multiphase particle discrimination with large volume statistics for mineral liberation, exposure, particle damage and tailing analysis.



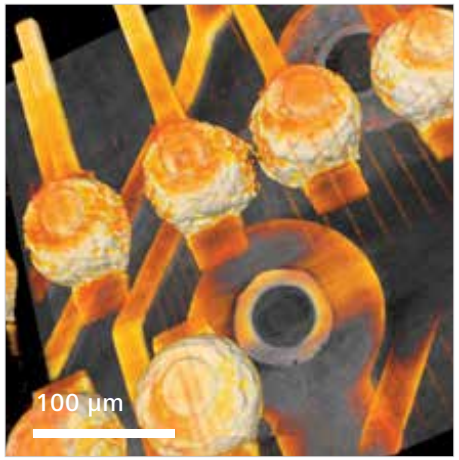
Neural crest of chick embryo showing cellular distribution



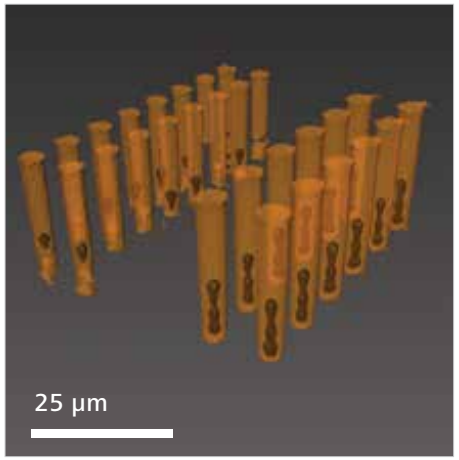
Mammalian Brain Tissue

Life Sciences

By offering maximum flexibility to tune absorption and propagation phase contrast mechanisms, ZEISS XRM solutions provide scientists with the highest contrast for stained and unstained soft tissue down to the cellular and subcellular level.



Bumps Short Defect



Voids in Through Silicon Vias (TSV)

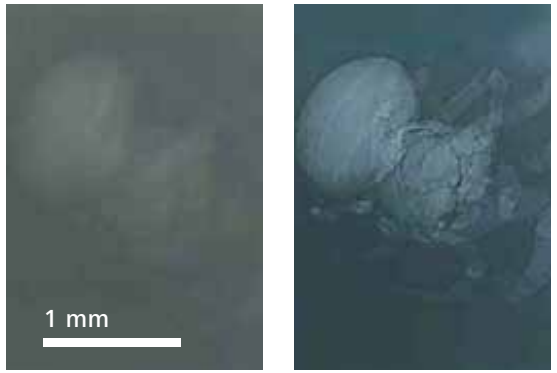
Electronics

ZEISS Xradia X-ray microscopes' architectural advantage in providing high resolutions at large working distances enables submicron imaging of large intact chips and packages, overcoming common limitations of 3D X-ray methods.

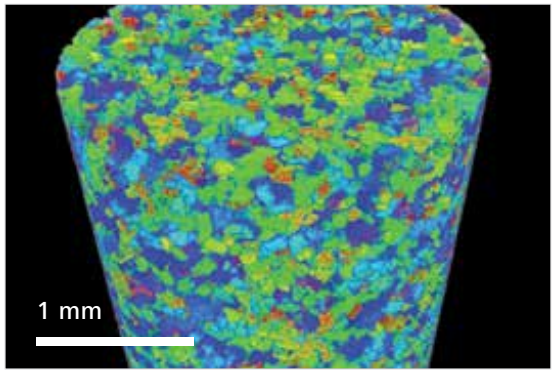
We make it visible.

Proprietary optics and detector technology from Carl Zeiss X-ray Microscopy overcome the shortcomings of conventional flat panel X-ray CT architecture. With best-in-class resolution, especially at large working distances and sample sizes, ZEISS provides the greatest flexibility for multi-length scale imaging and provides superior contrast for the widest range of materials.

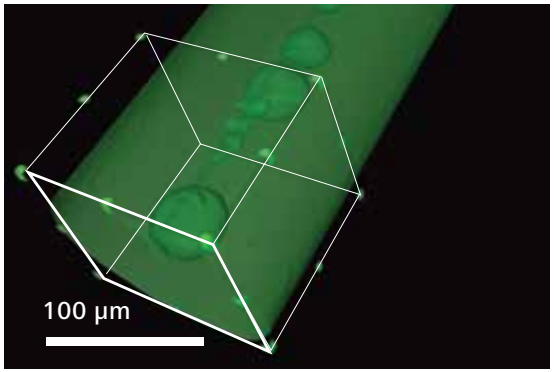
Conventional 2D-based approaches require serial or cross-sectioning that can result in damage and loss of data. ZEISS 3D XRM provide the mix of high-resolution, high contrast and large-volume, non-destructive sampling needed to advance science and innovation.

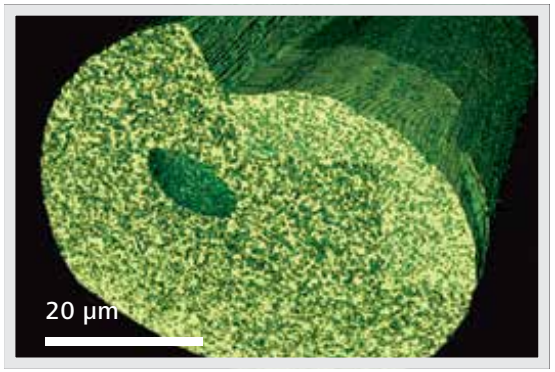


Unique Optimized Contrast Solutions *Spider fossil in amber (left) Absorption Contrast; (right) Absorption + Phase Contrast*

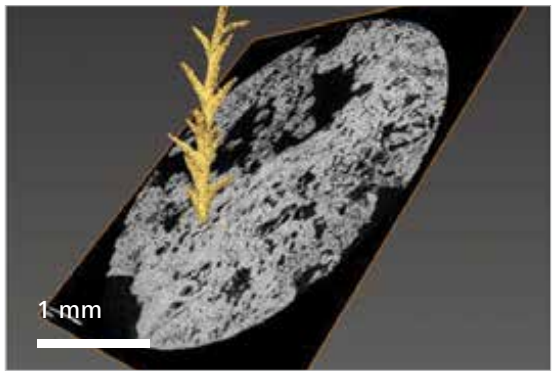


Multi-phase Imaging *Segmentation of crushed ore particles*

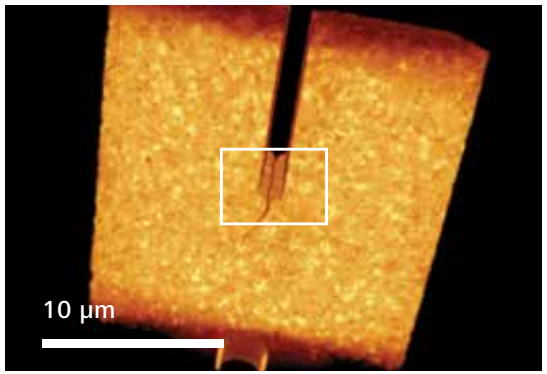


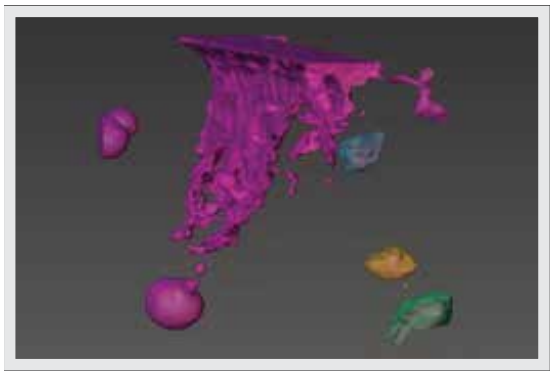


Multi-length Scale Imaging of Carbon Fiber *(left) Xradia Versa at 1 µm resolution shows voids; (right) Xradia 800 Ultra at 150 nm resolution with Zernike phase contrast provides detail*



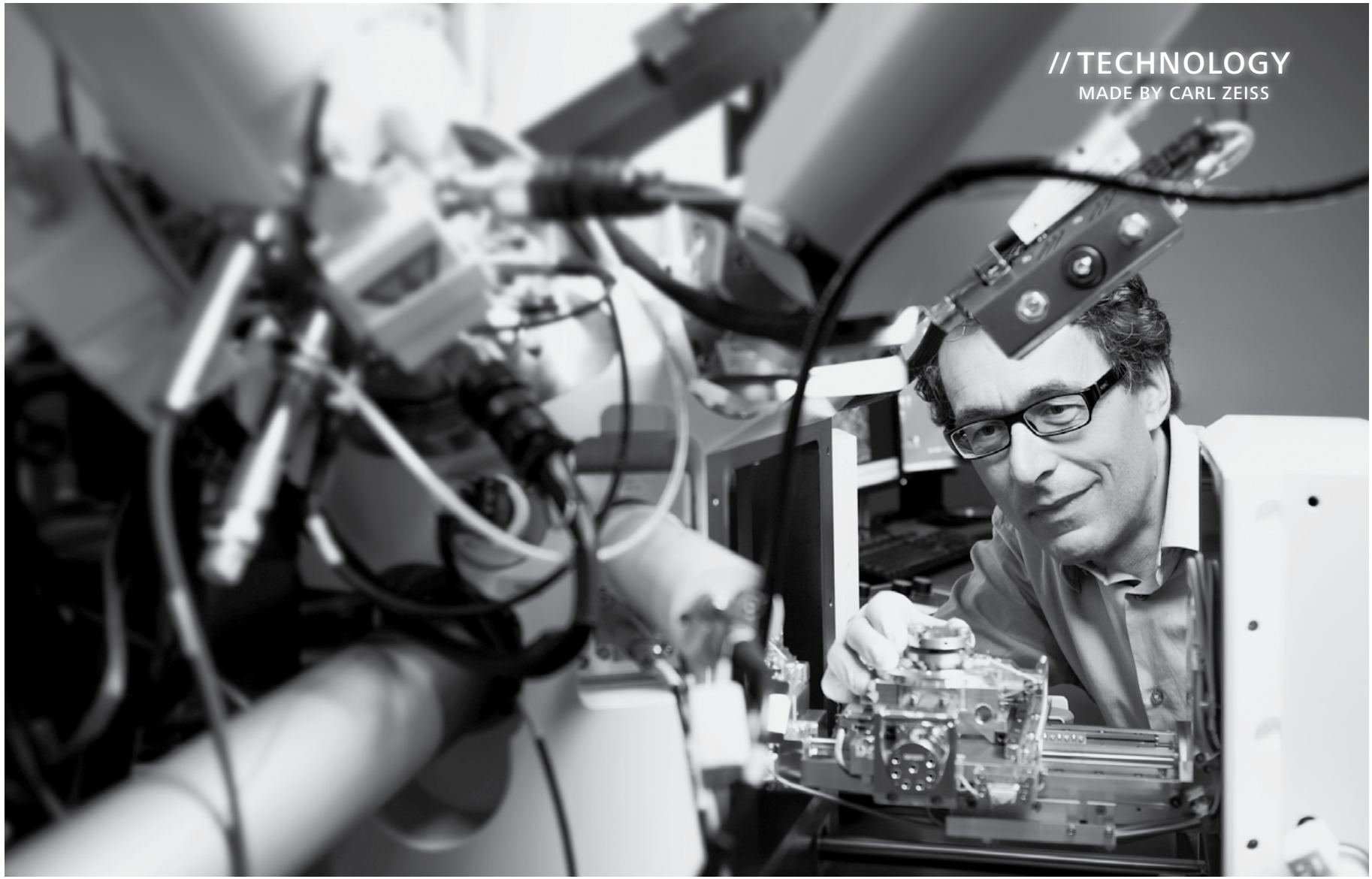
Segmentation of Materials of Like Densities
Phase Contrast – coral fossil in limestone





Interior Tomography *Crack propagation in refractory ceramic*

The moment "I think" becomes "I know".
This is the moment we work for.



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We make it visible.

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