

NXCT

National X-Ray
Computed
Tomography



NXCT @ Manchester

An EPSRC National Research Facility

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NXCT Mission

- › To provide access to X-ray CT to UK researchers
- › To provide support for experimental design, data acquisition and data analysis
- › Provide access to a 'library' of rigs for *in situ* experiments
- › Help turn data into understanding with computing and software access with support
- › Promote use of X-ray CT where it can make a positive impact

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Engineering and
Physical Sciences
Research Council



Equipment overview

› A wide range of:

- › Resolution
- › Object size
- › Scan speeds

› Making available:

- › Colour Lab CT
- › Phase contrast CT
- › Diffraction contrast CT

| | Mesoscale | Microscale | Sub-microscale | Nanoscale |
|-----------------------------|---------------------------------|------------------------------|------------------------|--------------|
| Seconds to minutes | | Fast in situ system | Walk-in sub-microscale | |
| Minutes to hours | Large object-high energy 450 kV | Large volume | | |
| | High energy scanner 450-750 kV | Fast microscale Metrology | Large volume | Nanoscale CT |
| Beyond attenuation contrast | | Grain imaging | 3D Histology scanner | |
| | | Colour Imaging | | |
| | | X-ray Phase contrast Imaging | | |
| | UoM | Soton | UCL | Warwick |

Capability strengths at Manchester

- › In situ imaging
- › Multiscale imaging
- › Rich tomography: Colour Imaging and diffraction imaging
- › Synchrotron experiments
- › Correlative Imaging
- › Metals
- › Composites
- › Earth sciences
- › Advanced analysis and reconstruction

NXCT New Equipment

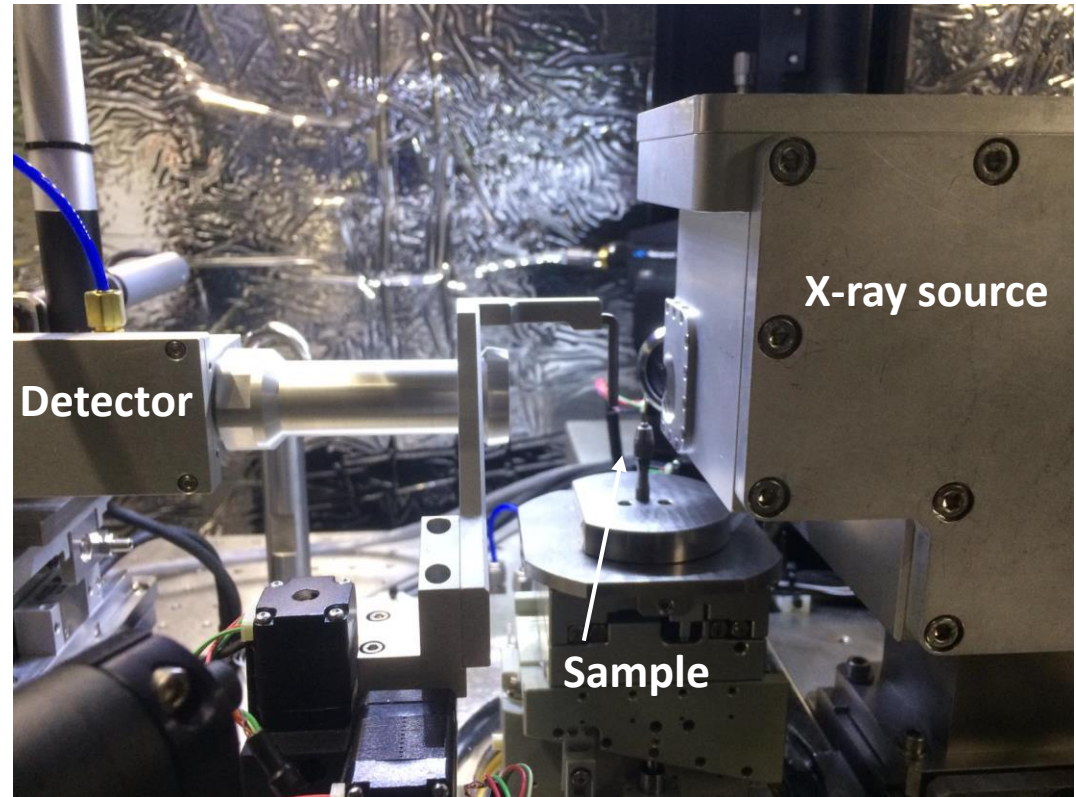
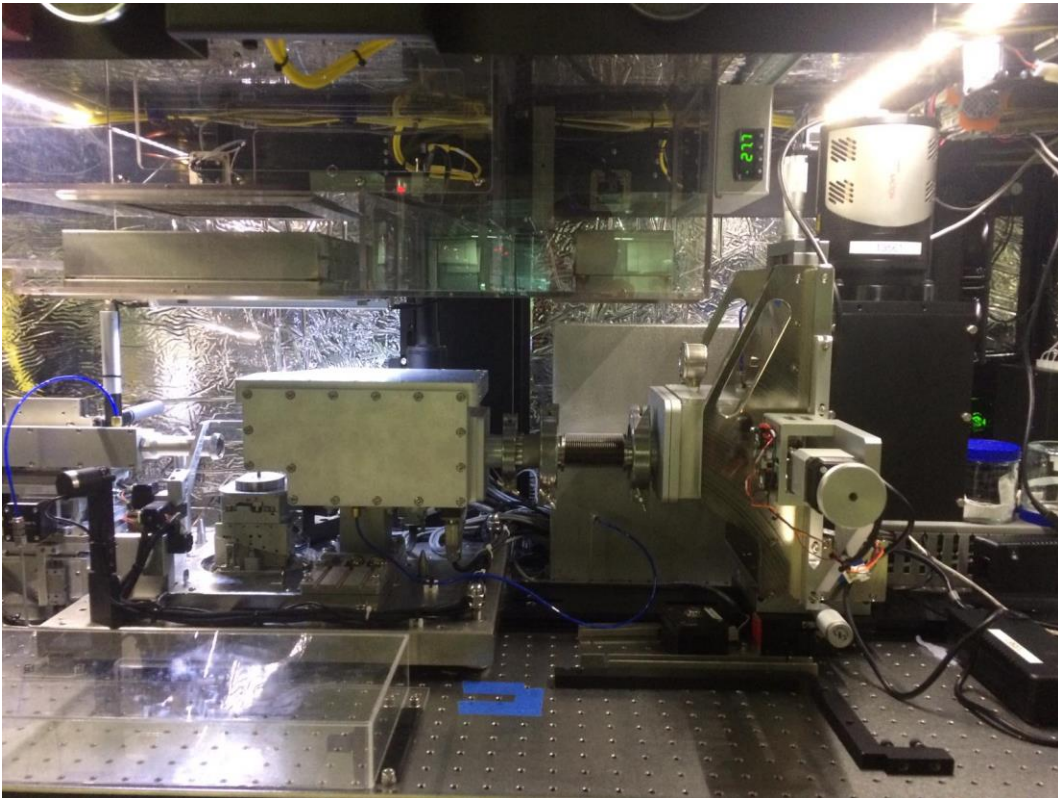
- › Fast sub-micron walk-in bay (UoM)- for in situ experiments
- › Large (voxel) volume scanner (UoM)- for datasets up to 10TB!
- › Hyperspectral CT scanner (UoM)*- for Colour imaging

* Home built systems dedicated to user experiments

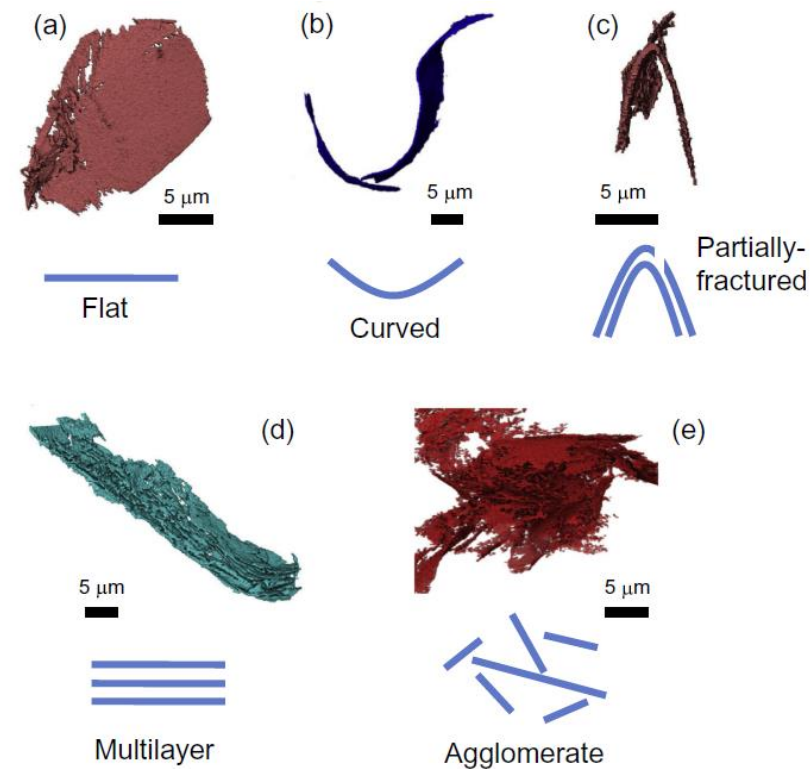
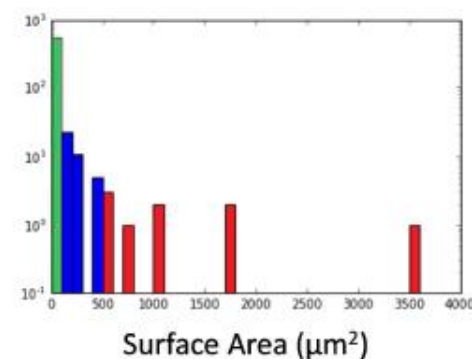
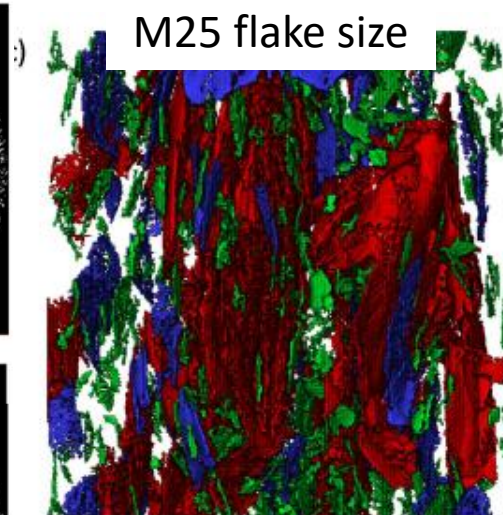
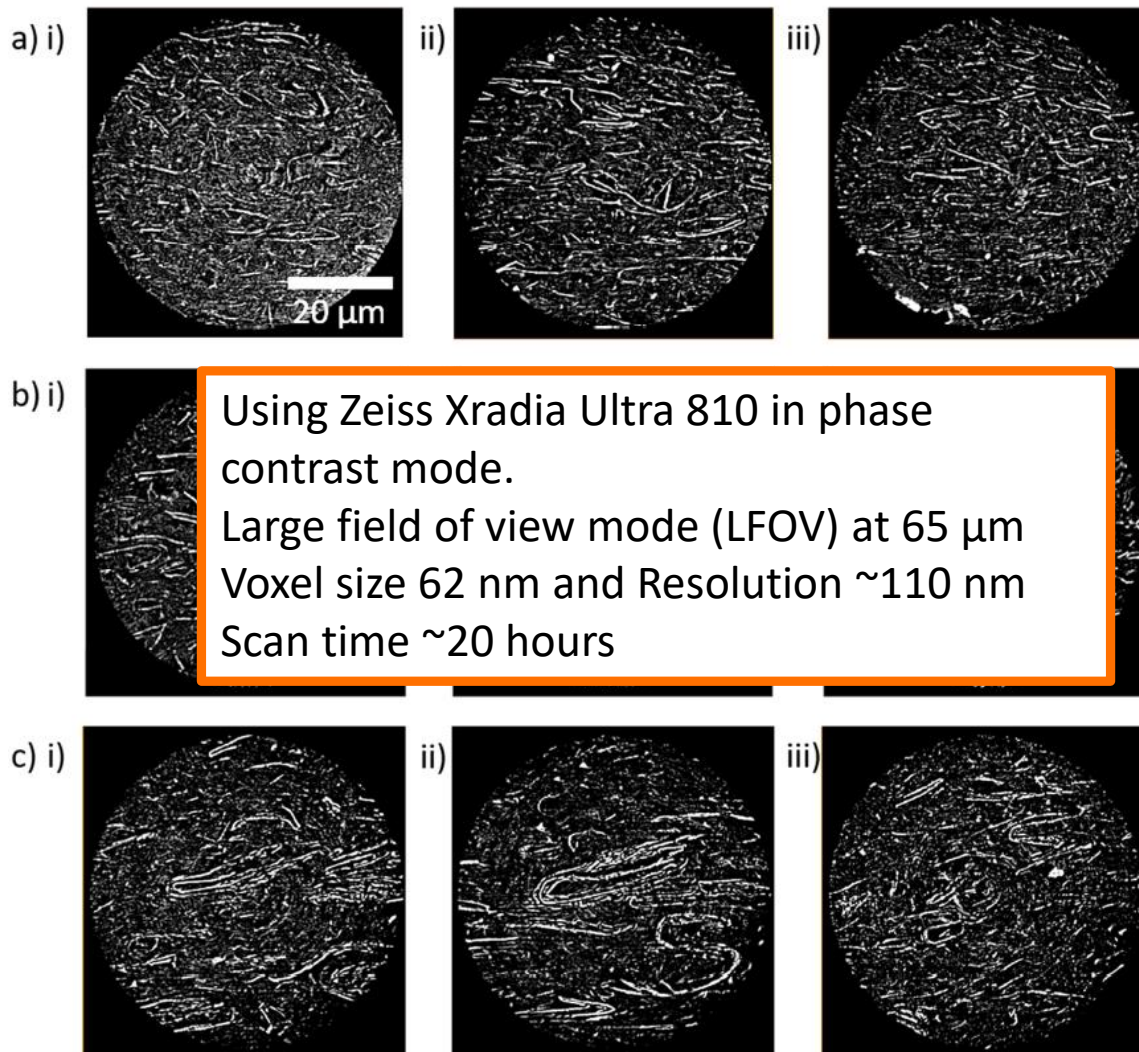


Inside the Zeiss Ultra 810 NanoCT

- 50 nm and 100 nm imaging at 5.5 keV with phase contrast
- Very limited sample size 35 μm of steel, >100 μm polymer FOV is 65 μm

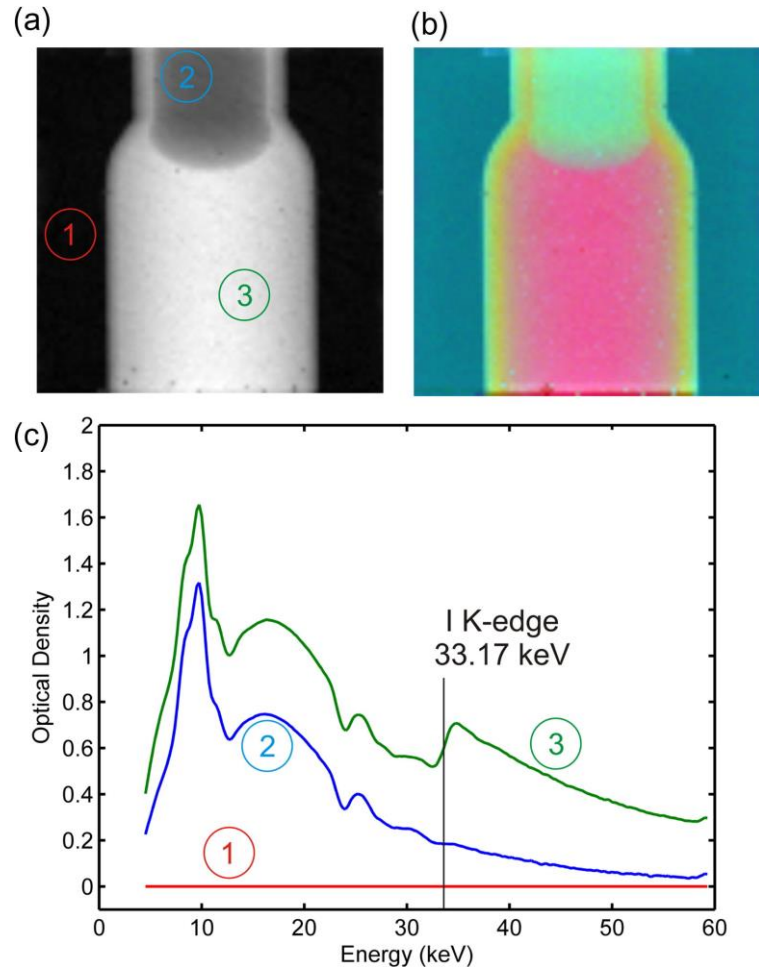


NanoCT using phase contrast: Nanocomposite

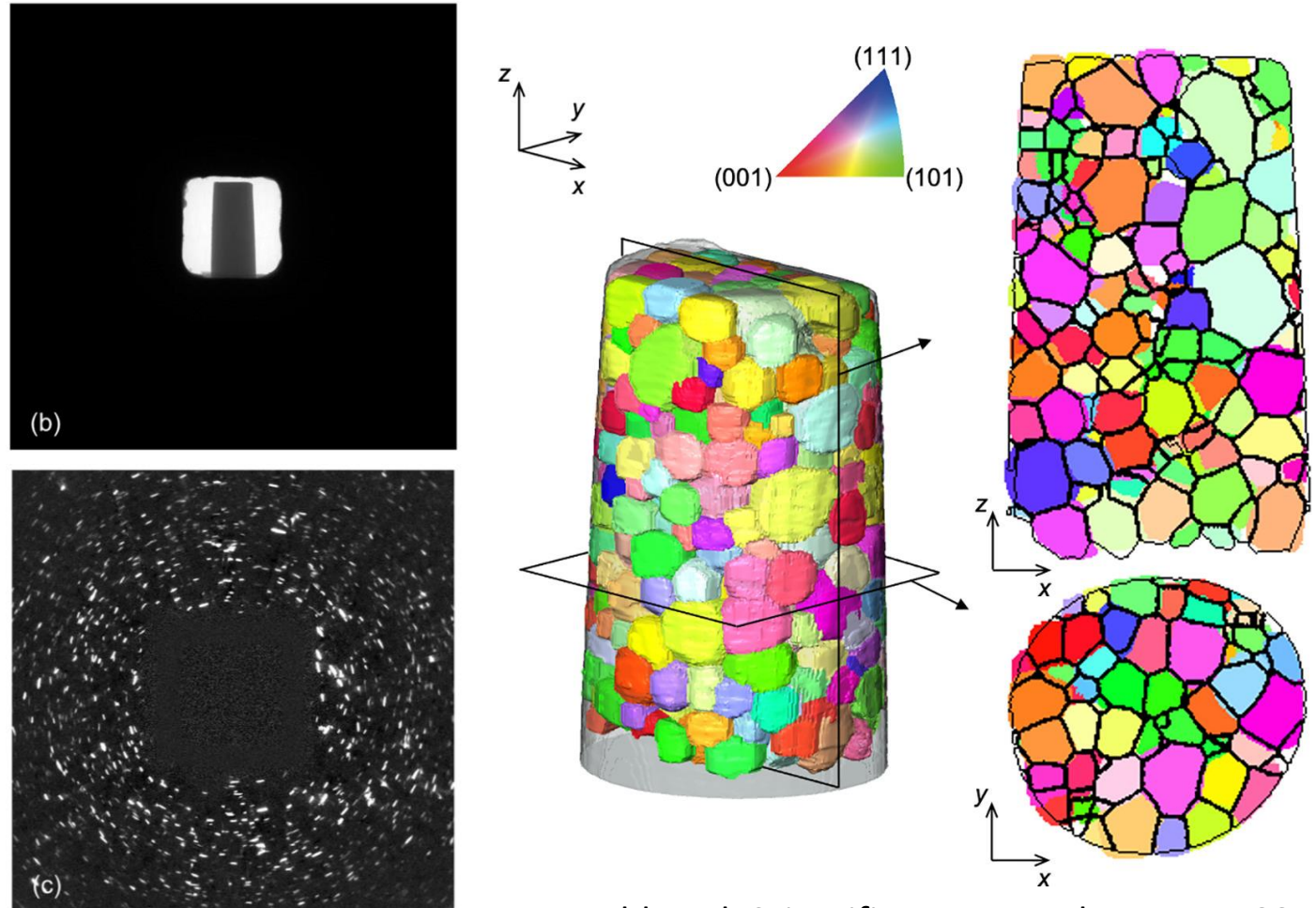


Colour and Diffraction Imaging

Hyperspectral/Colour (energy sensitive) CT



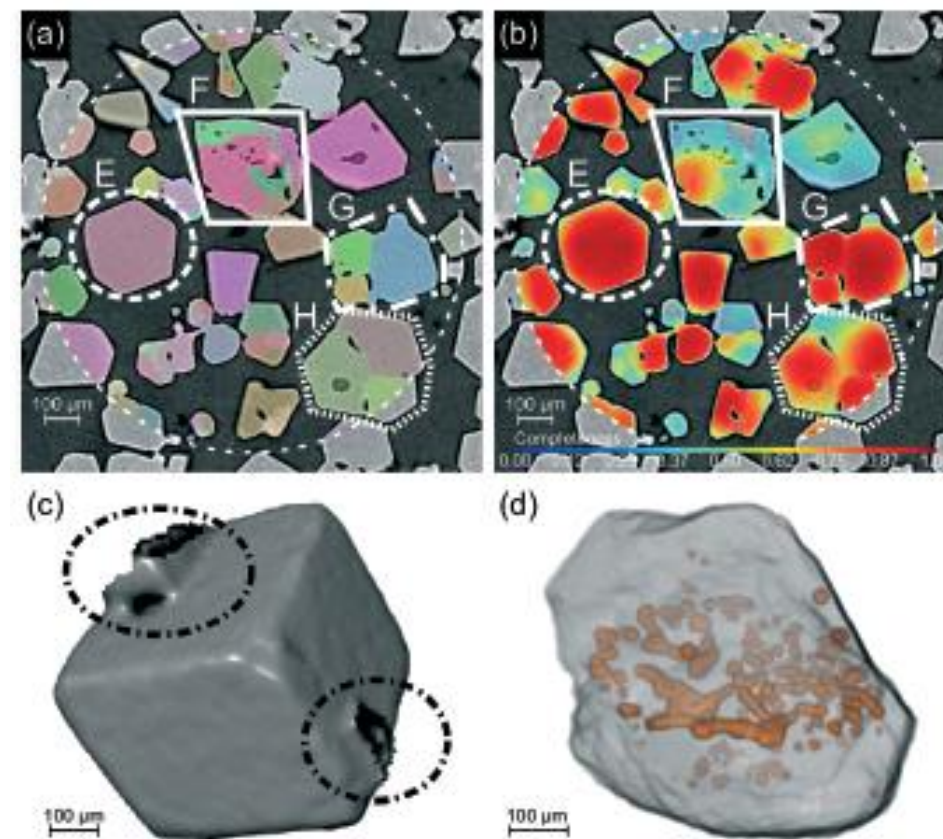
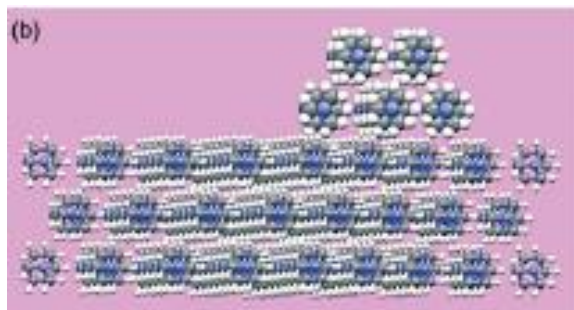
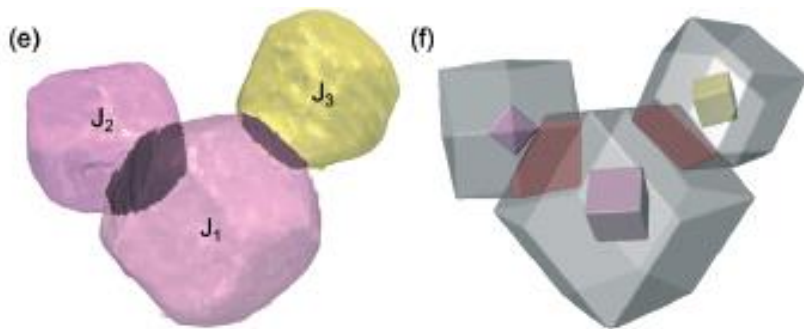
Diffraction Contrast Tomography (DCT)



McDonald et al, Scientific Reports volume 5, 14665 (2015)

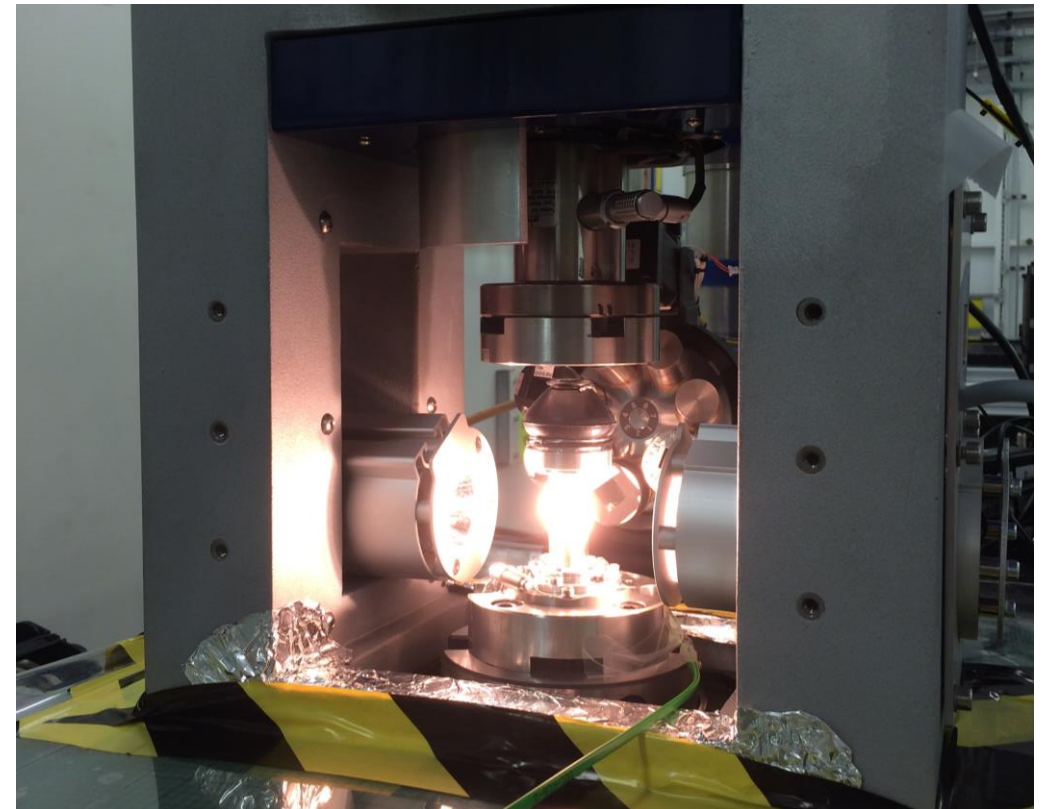
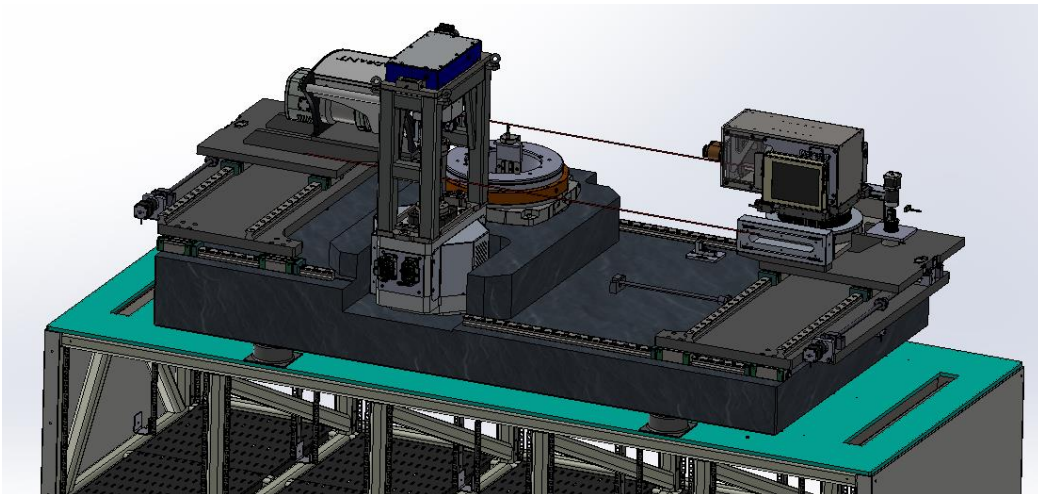
Crystallography of organic powders

- Hexamine used in chemical industries
- It's behaviour during storage and processing as well it's interaction with other powders needs to be understood based on the surface properties which can be determined by the crystal termination



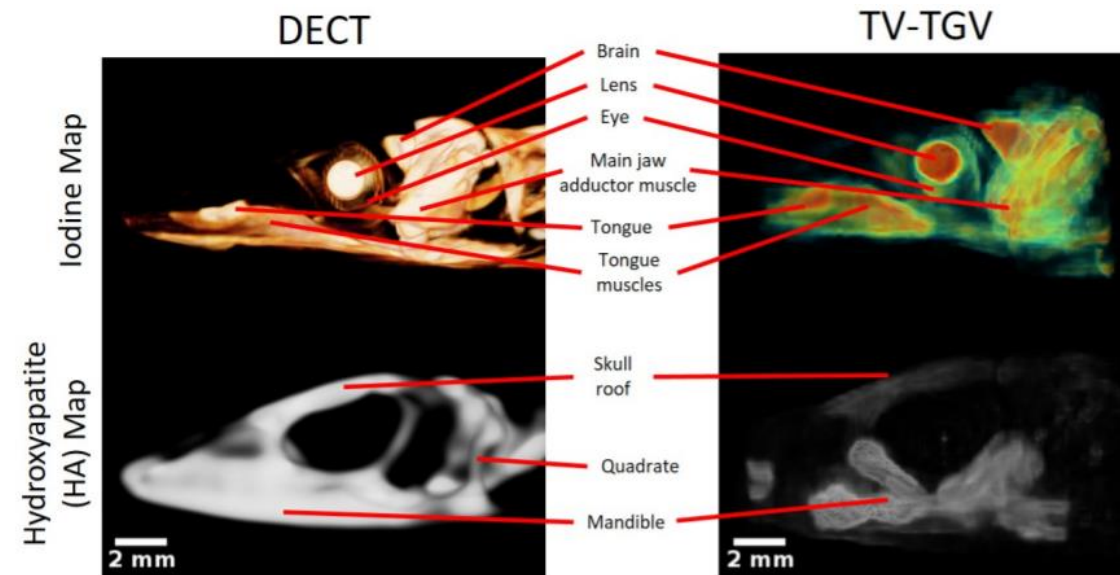
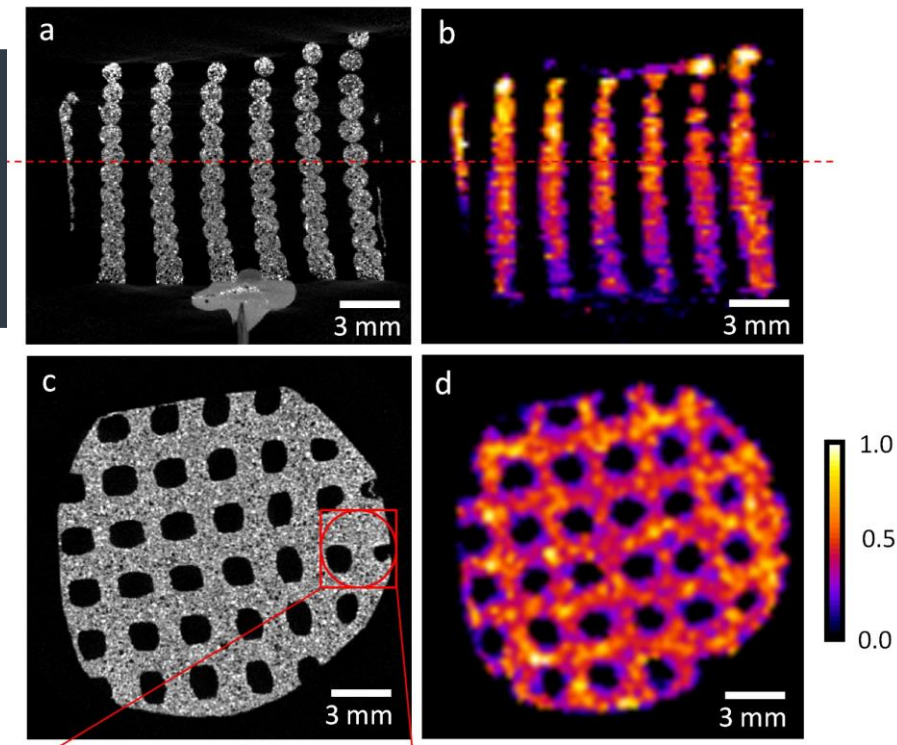
Fast sub-micron in situ scanning @UoM

- Custom Sigray Prisma
- 2 beamlines-1 rig integrated
- 30-160 kV, 25 W power
- High capacity air bearing stage
- 2 fast flat panels 2x optically coupled detectors
- Tension, compression and torsion
- With IR heaters and 1200 °C furnace

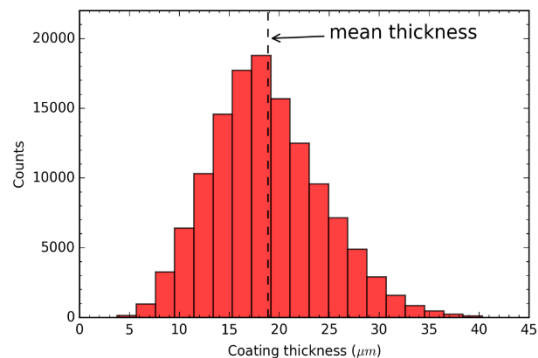
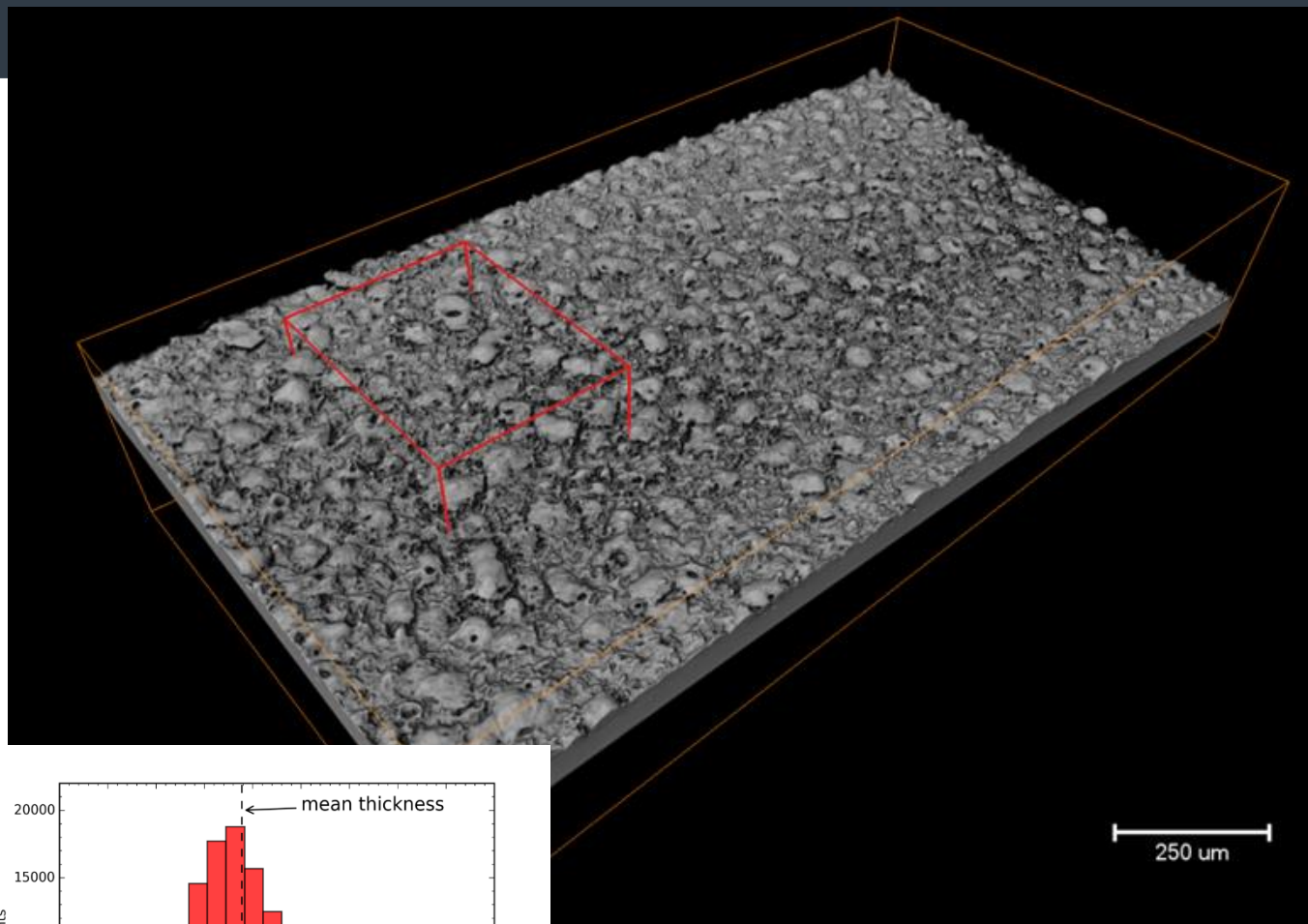


Colour CT system @UoM

- NXCT building a lab-based Colour CT system-due 2022
- Hexitec detector
- Pixel Size: $250\text{ }\mu\text{m} \times 250\text{ }\mu\text{m}$ (6x2 array)
- Number of Pixels: $80 \times 80 = 6400$ (76,800)
- Energy Range: 4-200 keV
- Energy Resolution per Pixel: 800 eV average at 60 keV
- Frame Rate: 9 kHz
- Data Rate: 5M photons/second
- Standard Detector Material: 1 mm thick CdTe
- Dimensions: 21 x 5 x 5 cm (for 1 tile)

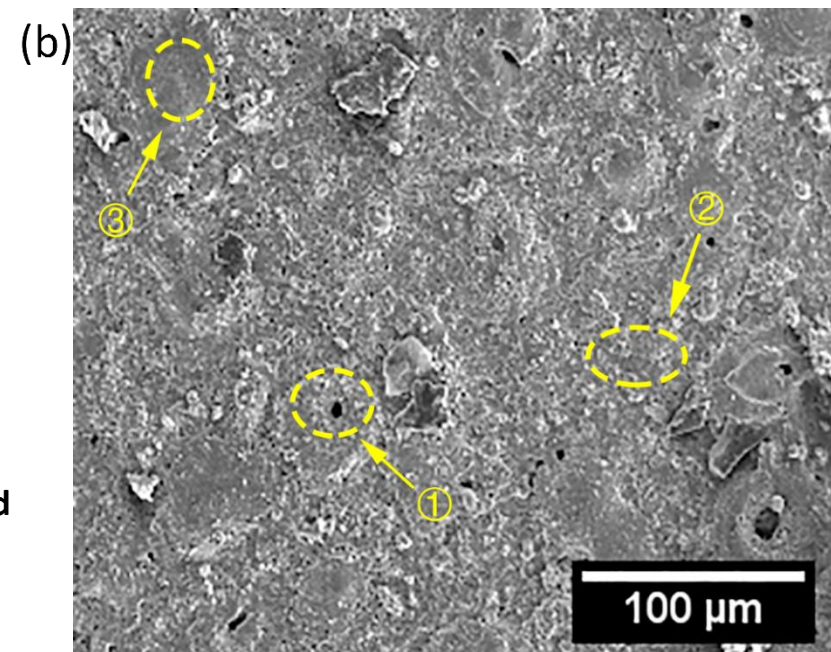
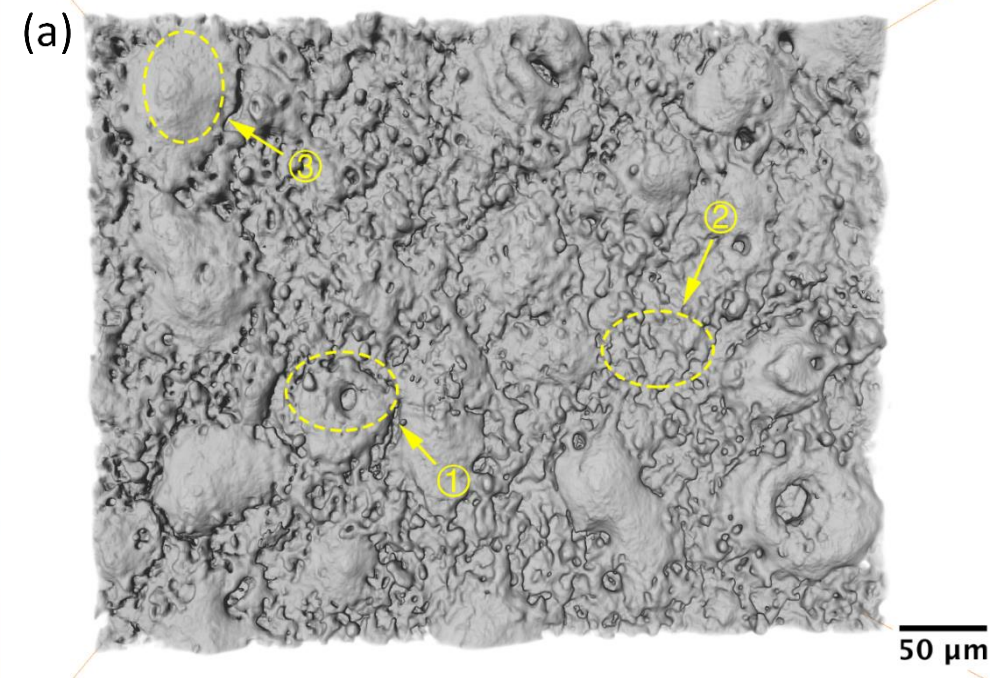


Correlative Imaging: PEO on Ti

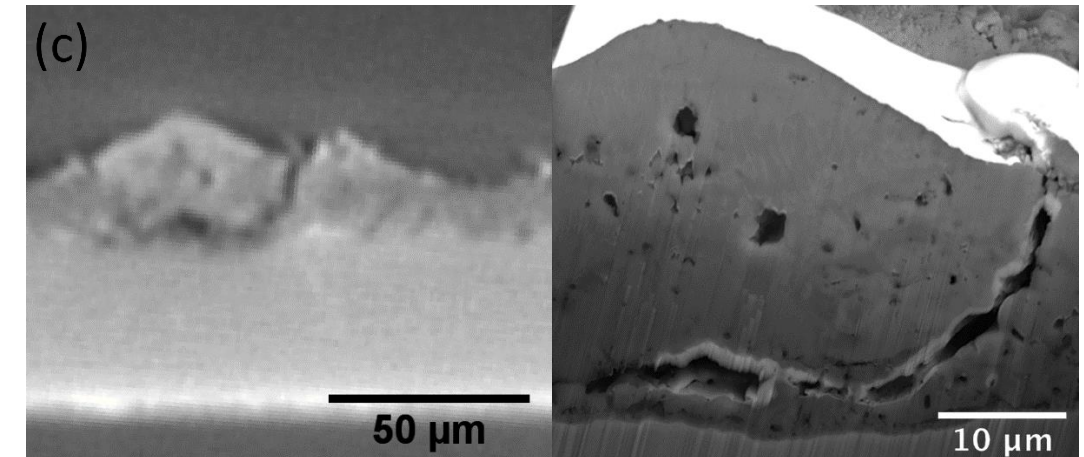
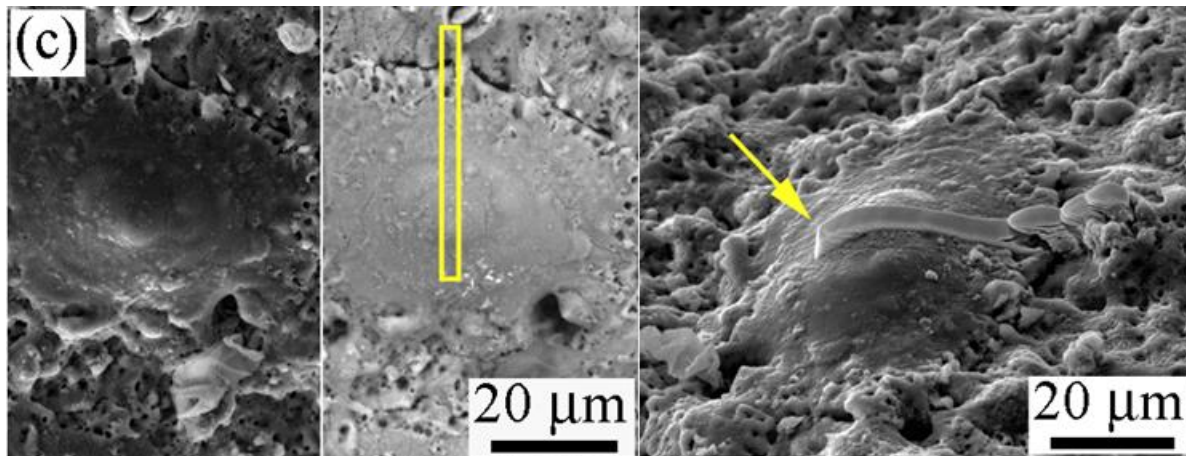
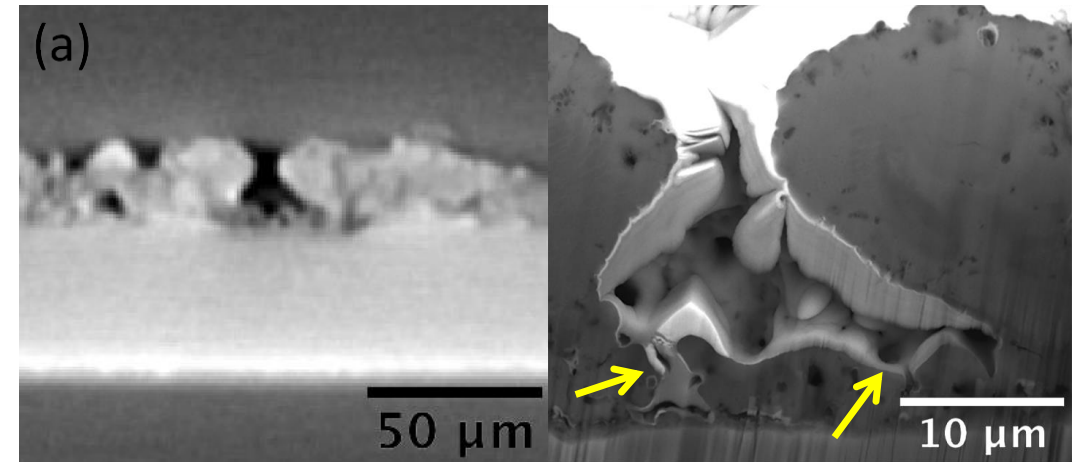
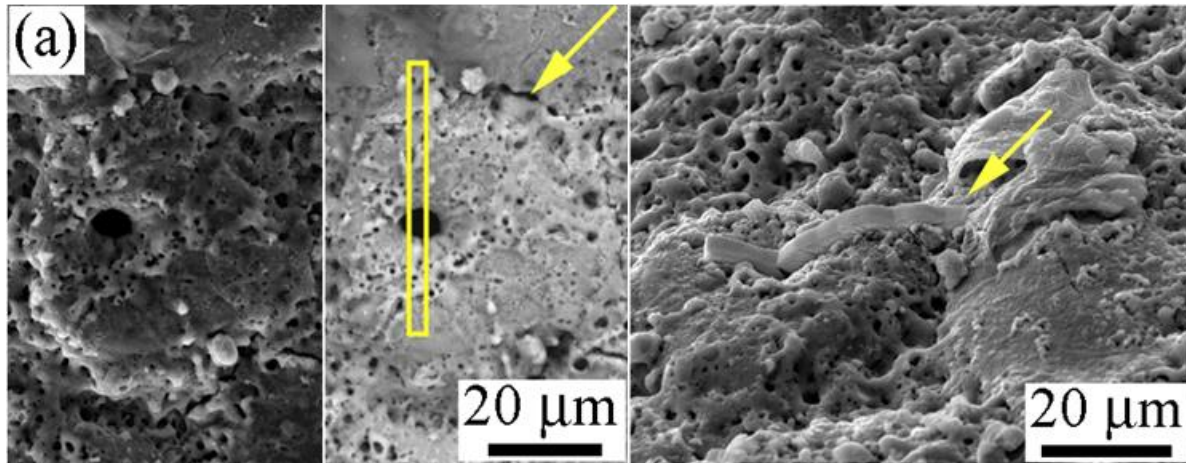


X-ray computed tomographic investigation of the porosity and morphology of plasma electrolytic oxidation coatings

X. Zhang, et al, ACS applied materials & interfaces, Volume 8, Issue, 13 (2016), pp. 8801-8810

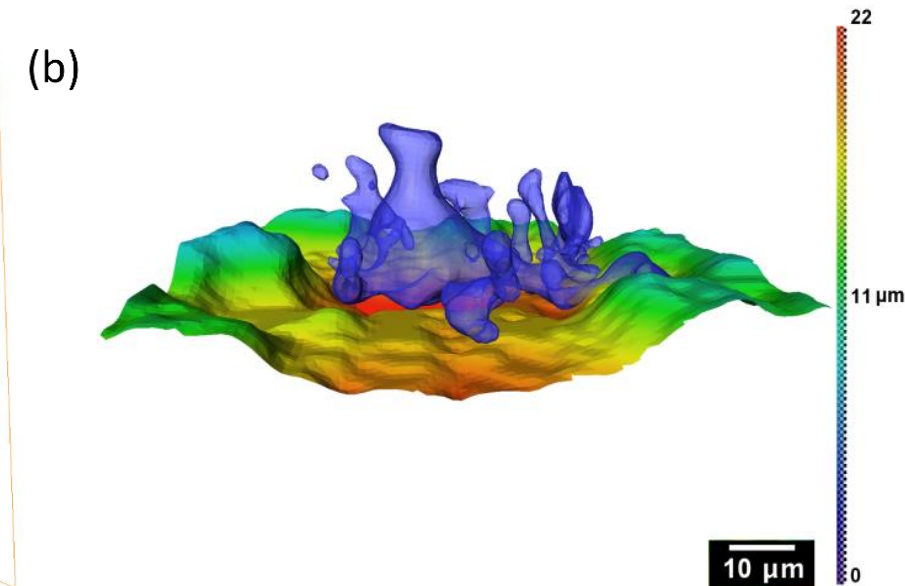
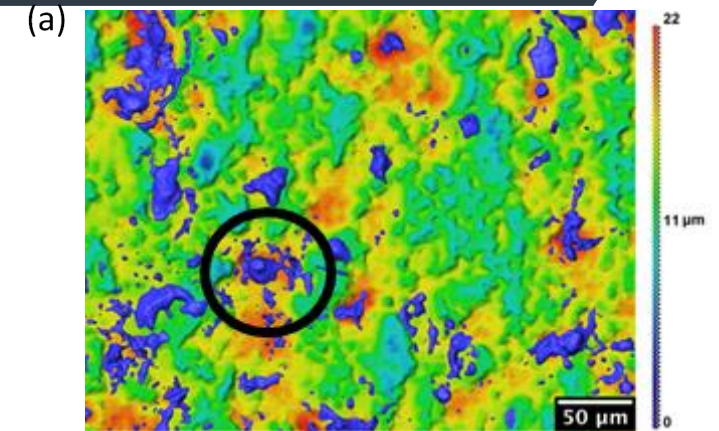
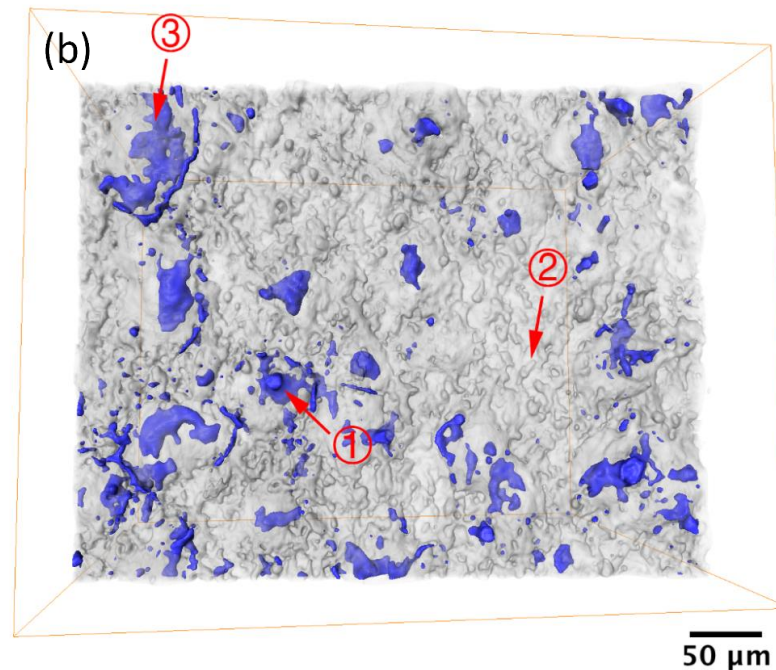
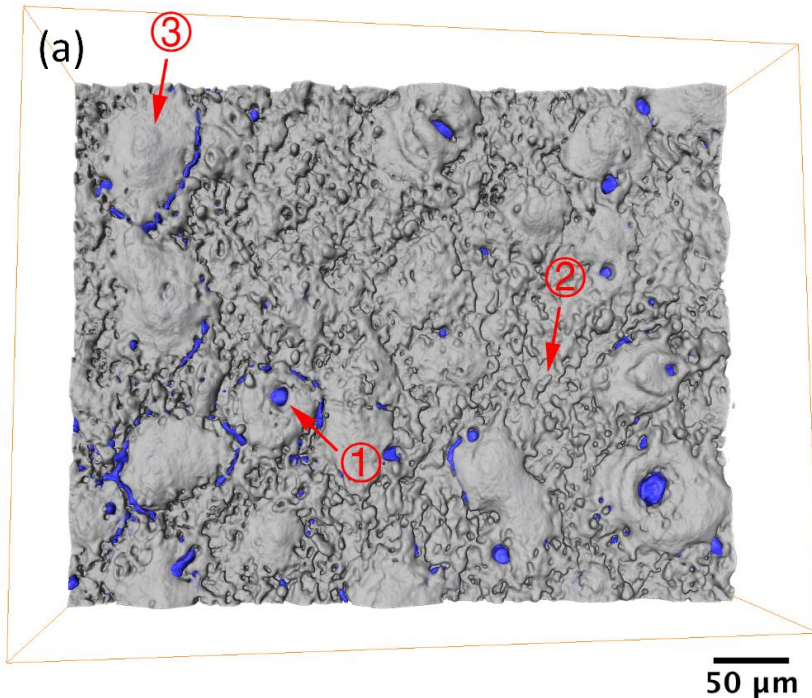


Correlate regions of Interest: XCT:SEM:XCT:FIB



Quantify features: Understand Mechanisms

- Understand where large surface connected porosity occurs-correlate to features
- Large single 'eruptions' are detrimental to the coating performance



Thank you for listening

<https://nxct.ac.uk>