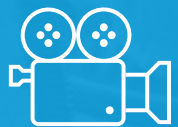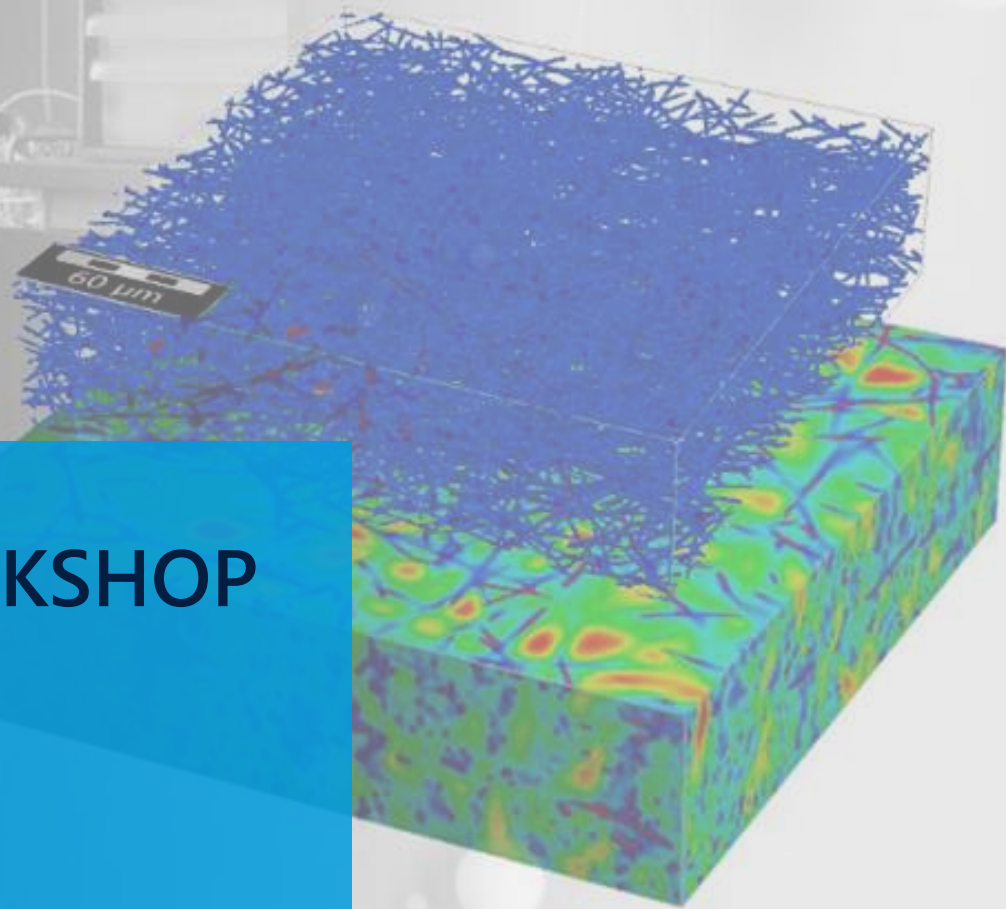# WELCOME TO RIGAKU VIRTUAL WORKSHOP

DEEP DIVE: FILTRATION ANALYSIS
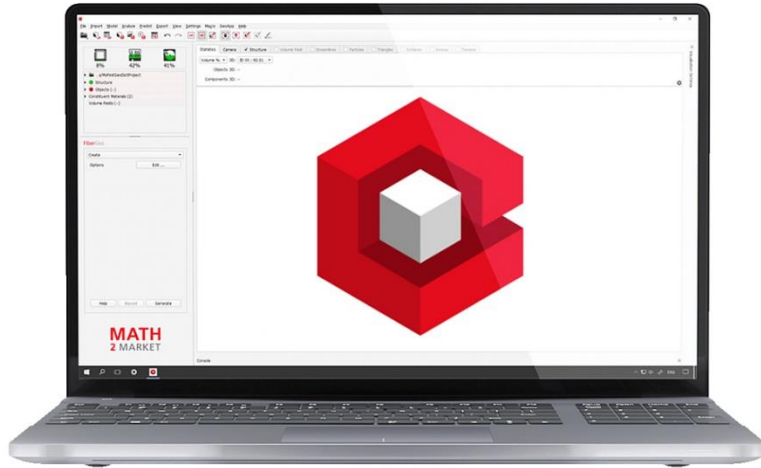
1. Data Collection

Watch the recording

Presenter: **Angela Criswell** | Senior Scientist
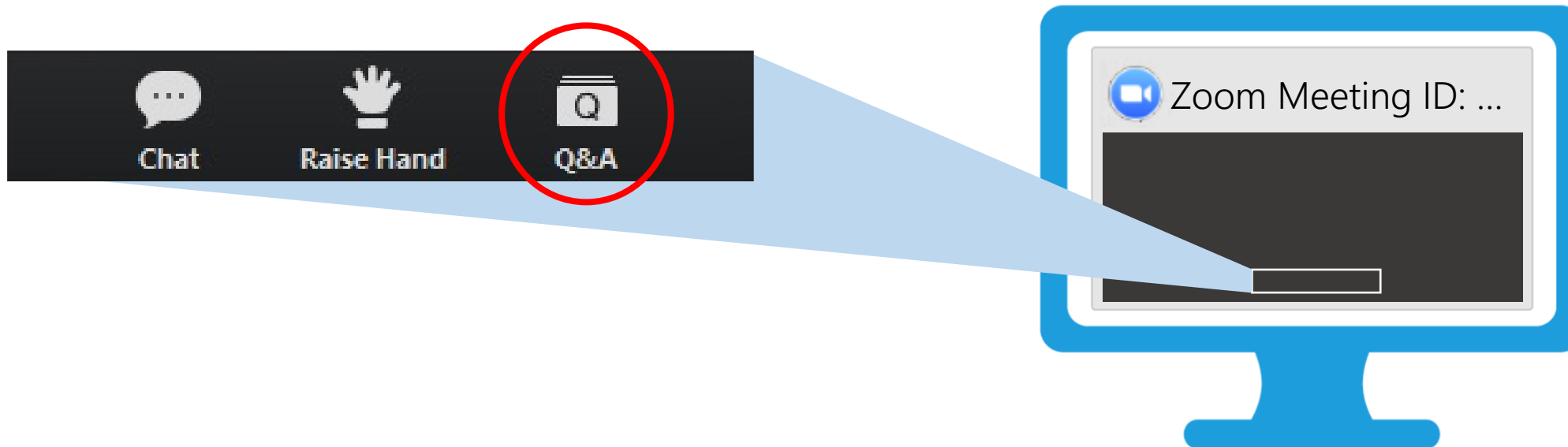
Co-presenter: **Aya Takase** | Director of X-ray Imaging

Host: **Tom Concolino** | Analytical X-Ray Consultant

Phillip Eichheimer, Ph.D. | Math2Market

Application Engineer

You can ask questions during the presentation.
We might turn on your microphone for further discussions.

Recording will be available tomorrow.

Filtration Analysis – 1. Data Collection

Virtual Workshop presented by Angela Criswell

FILTRATION ANALYSIS SERIES

1. Data collection

2. Segmentation and property analyses

3. Filtration simulations
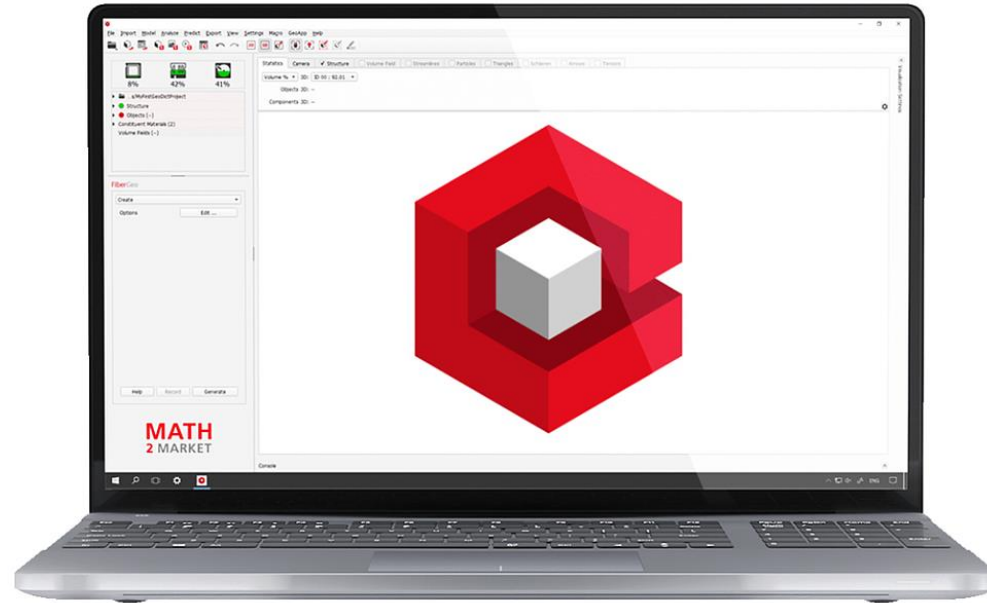
THINGS WE'LL COVER

- Filtration basics

- How to collect high-quality CT data for filter media

- How to evaluate image quality and suitability for fiber analysis

nano3DX by Rigaku
High resolution and high contrast for soft materials

GeoDict by Math2Market
The Digital Material Laboratory

WHAT IS FILTRATION?

Filtration

The process in which solid particles in a liquid or gaseous fluid are removed using a filter medium that permits the fluid to pass through but retains the solid particles

MANY INDUSTRIES UTILIZE FILTRATION

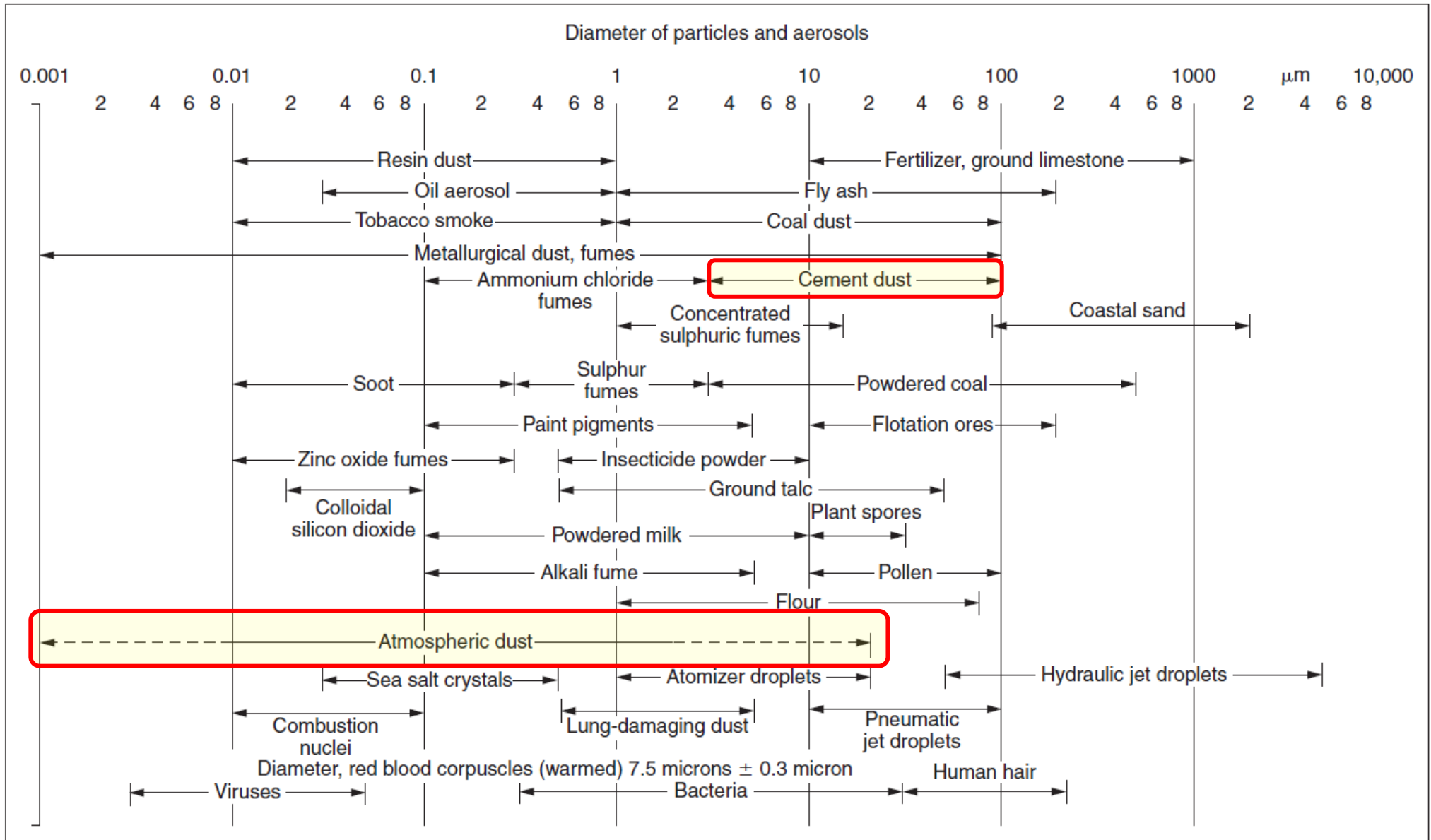# DIFFERENT LENGTH SCALES FOR FILTERS

Complete filter

mm – m

Pleated filter

mm
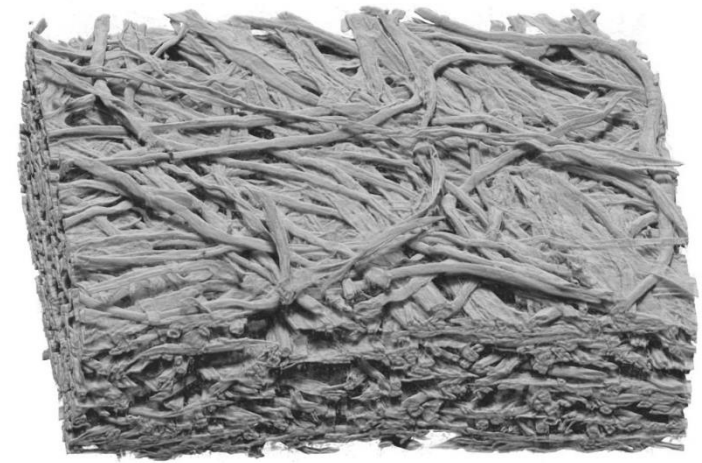
Filter media

μm

Sutherland, K., 2008. "Filters and filtration handbook," 5th ed. Elsevier/Butterworth-Heinemann, Oxford.

WHAT MIGHT WE ALREADY KNOW?

- Particle size range for contaminants we want to filter.
- Manufacturing condition and possibly some preliminary tests
  - Grammage (mass per unit area)
  - Fiber dimensions (diameter, length, shape)
  - Binder material and volume percentage
  - Particle capture efficiency (d_{10}, d_{50}, d_{90})

CT data
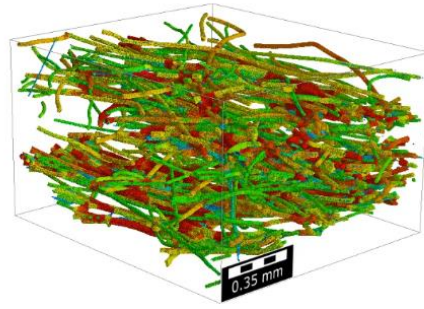
Filter media analysis
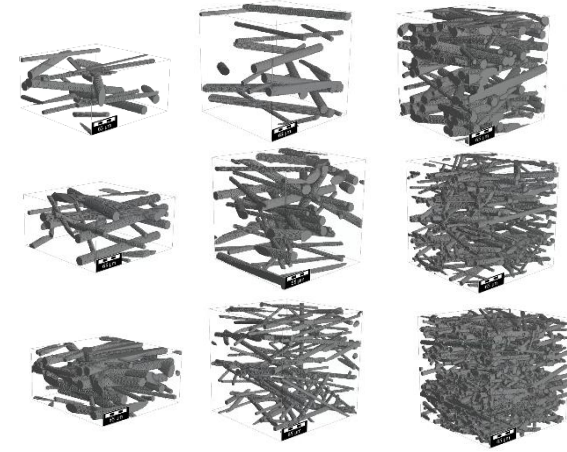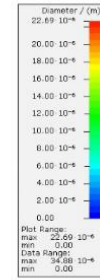
Filter media modeling

Filter optimization
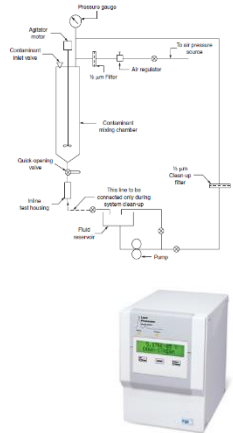
Testing

Manufacturing
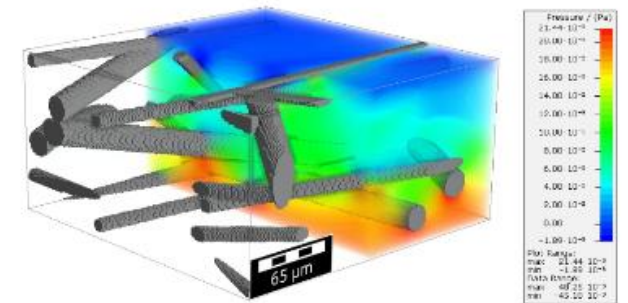
Filtration simulations

HOW DO WE ACHIEVE HIGH RESOLUTION?

X-RAY SOURCE (Cr, Cu, Mo, W)
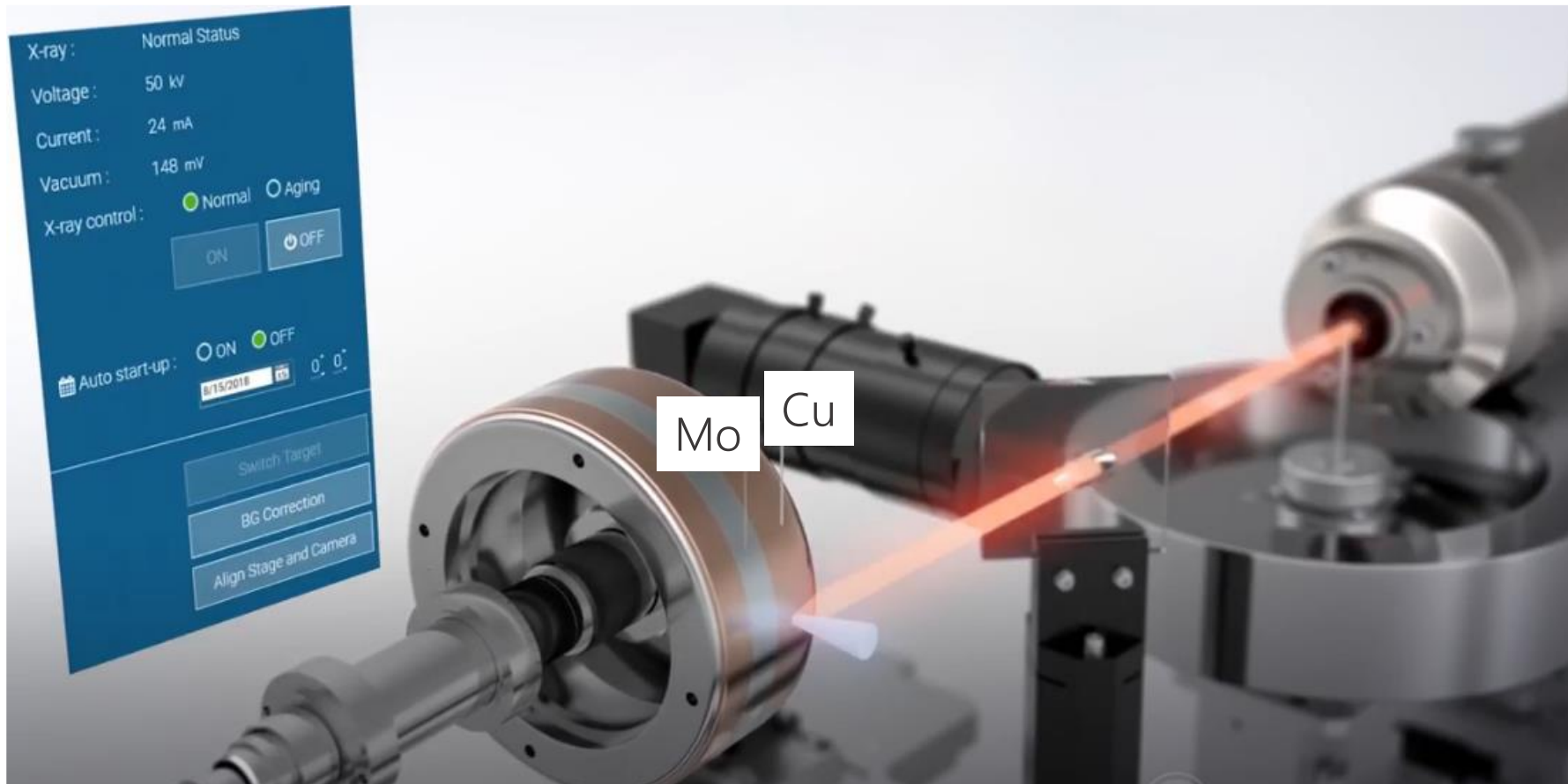
X-RAY ENERGY

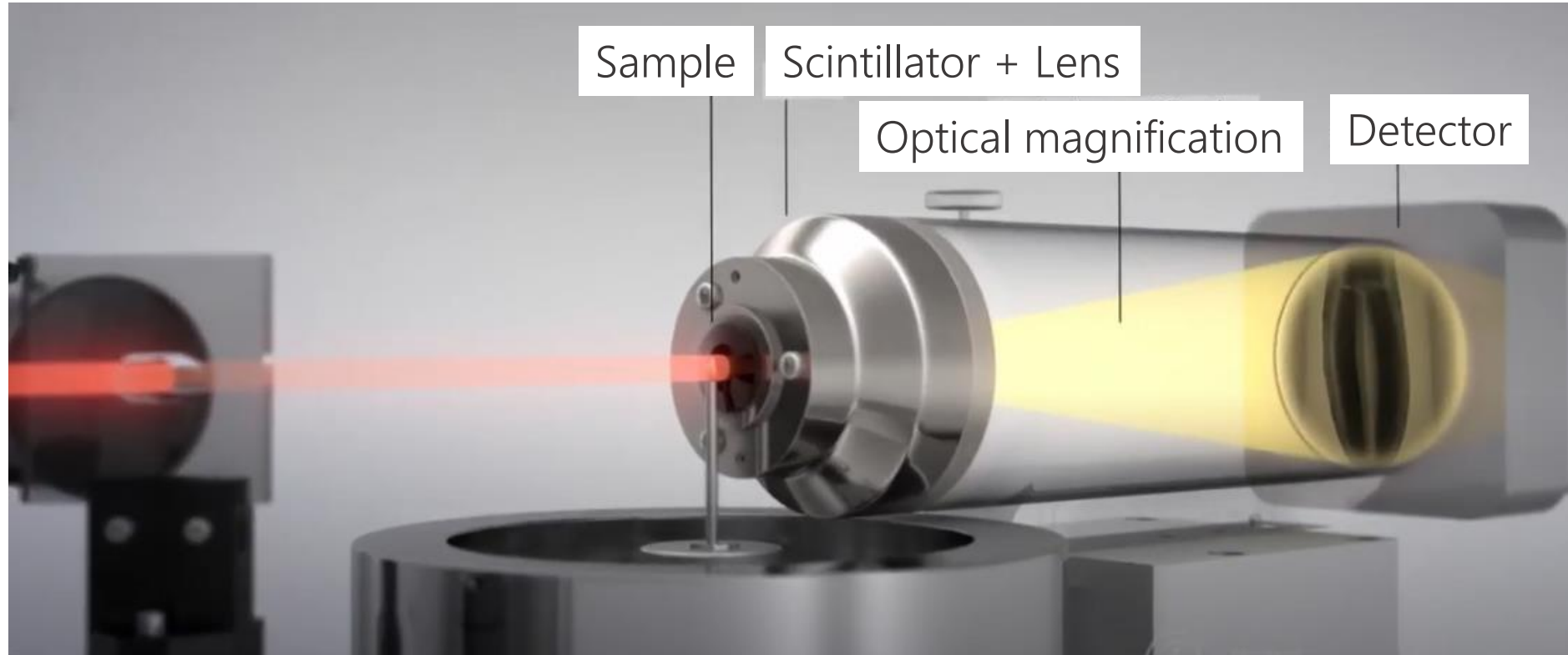- nano3DX (selectable target)
  - Cr, Cu, Mo
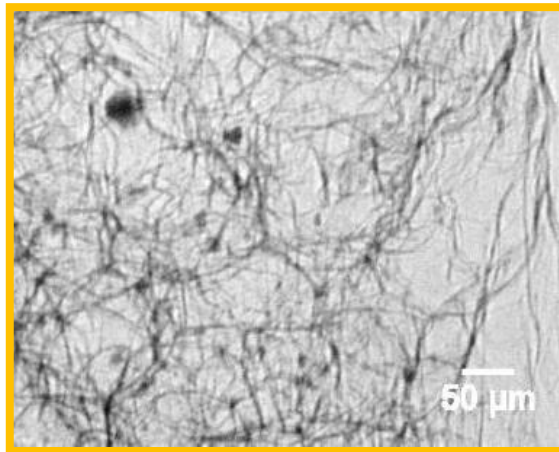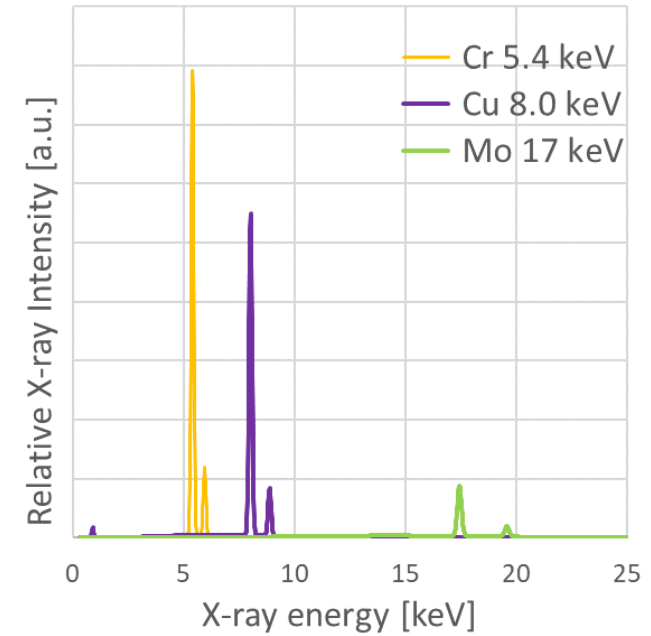
Cr target 5.4 keV
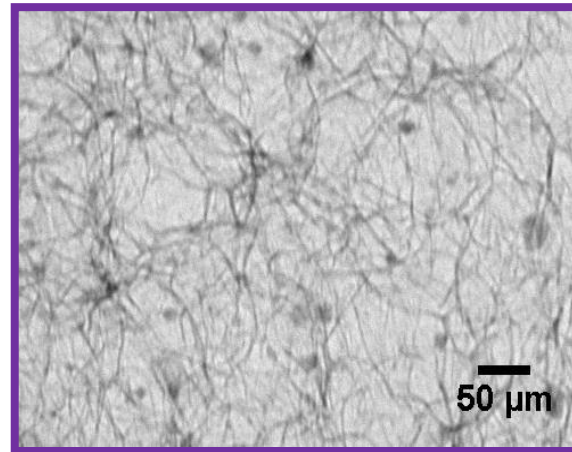
Cu target 8 keV
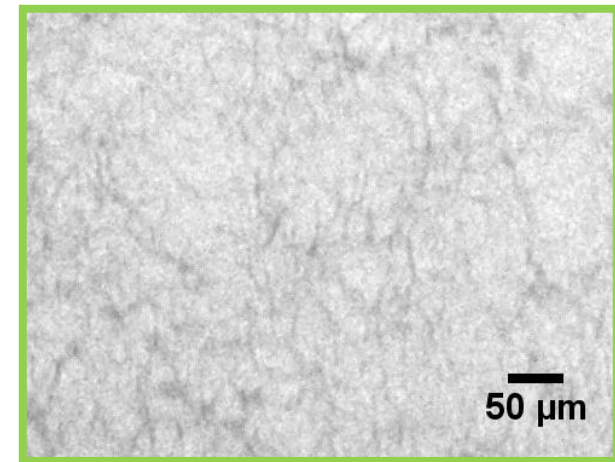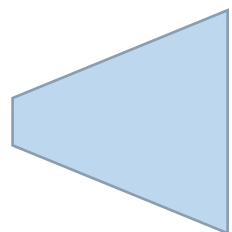
Mo target   17 keV

PARALLEL BEAM GEOMETRY

Sample

Scintillator + Lens

Optical magnification

Detector

Lens magnification	FOV	Voxel resolution
20X	0.7 mm	0.325 μm
10X	1.3 mm	0.66 μm
5X	2.6 mm	1.3 μm
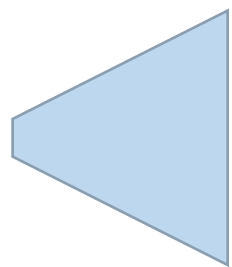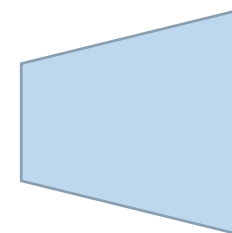
WHAT DATA COLLECTION SETTINGS SHOULD WE CONSIDER?

What happens when we image with different voxel size?

	1.3 μm	2.6 μm	3.8 μm	5.1 μm	10.3 μm
	— 16.64 μm	— 17.92 μm	— 19.15 μm	— 25.65 μm	— 30.9 μm
Fiber diameter	— 17.7 μm	— 19.2 μm	— 21.1 μm	— 24.0 μm	— 39.8 μm
Porosity	0.96	0.96	0.95	0.95	0.92
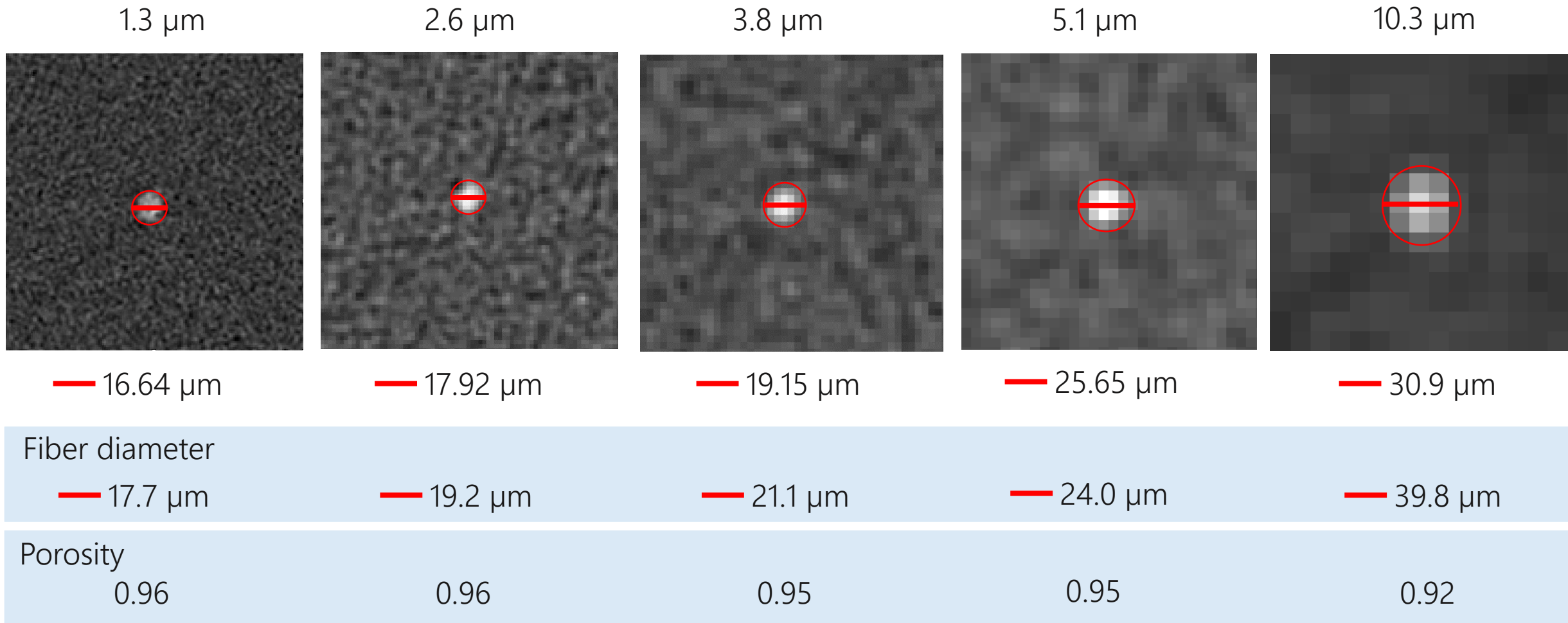
What happens when we image filter with differing voxel sizes?
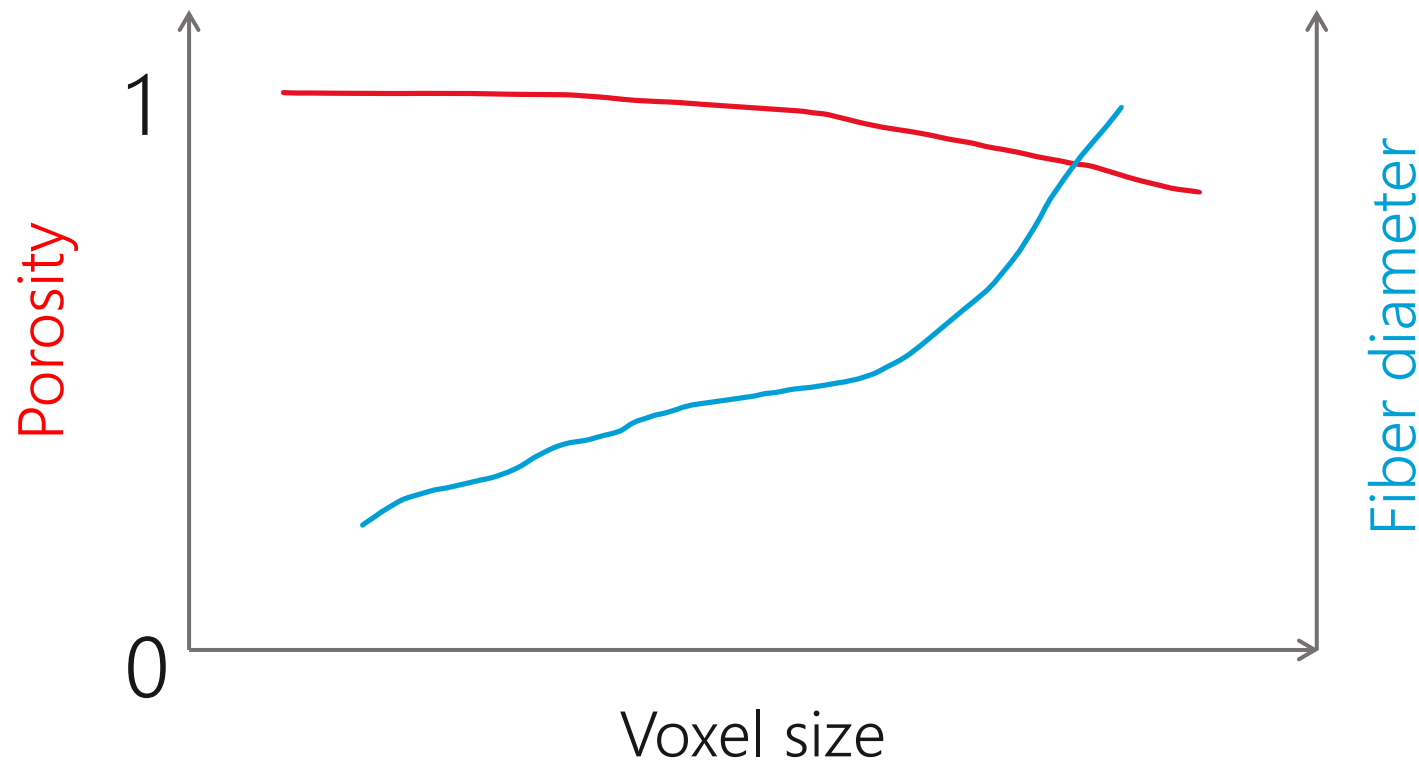
Rule of thumb: Voxel size should be < 0.2 * fiber diameter

What happens when we image filter with differing voxel sizes?
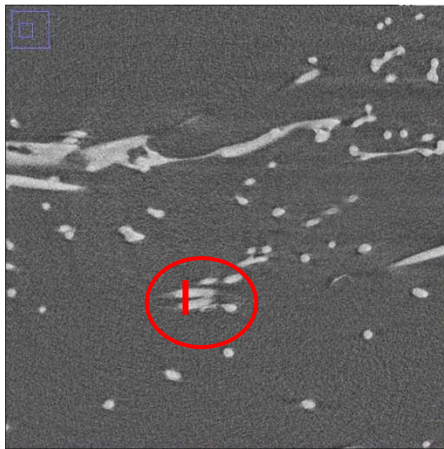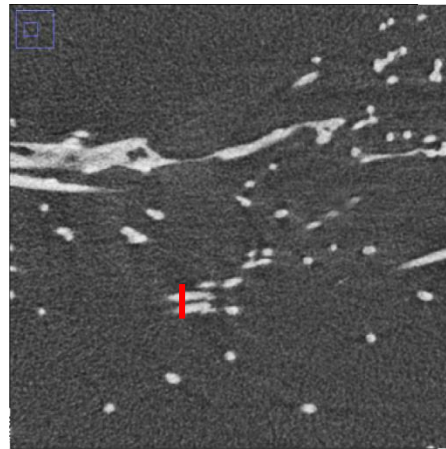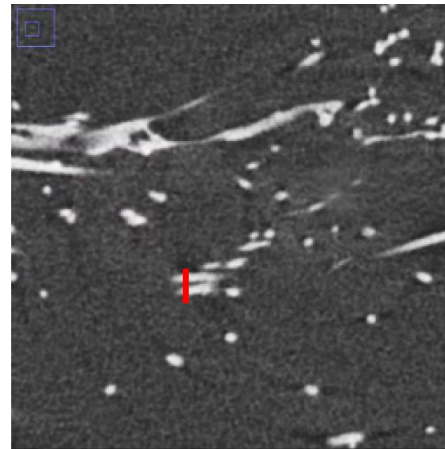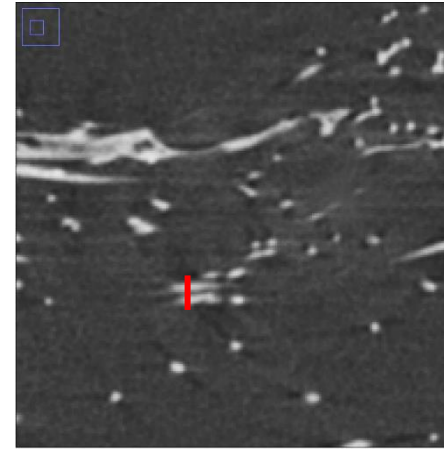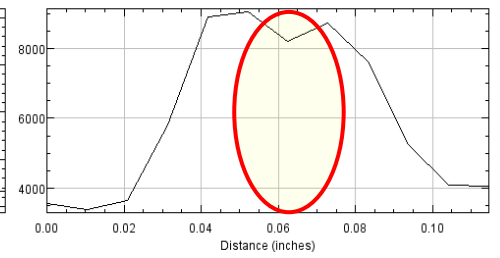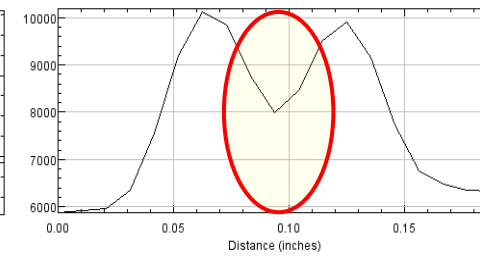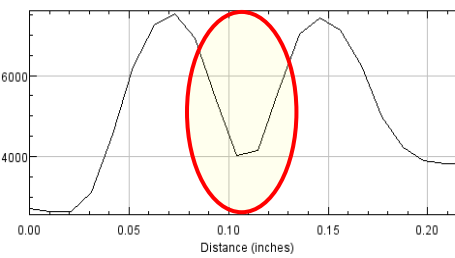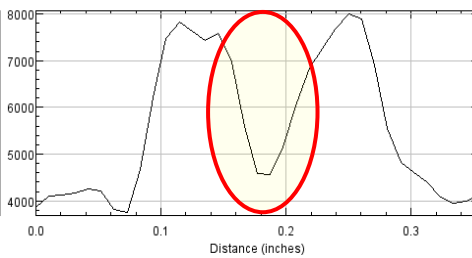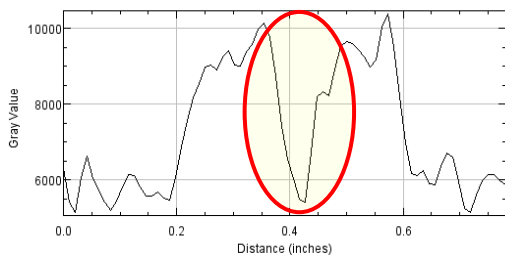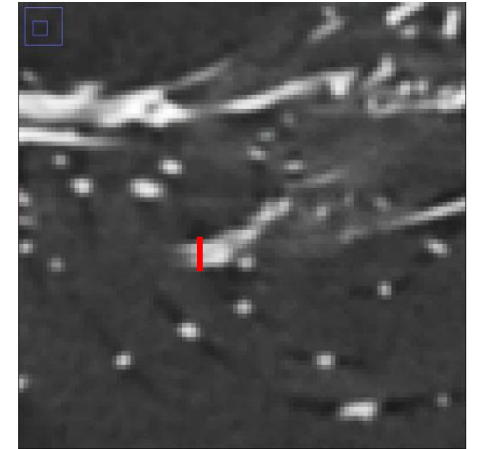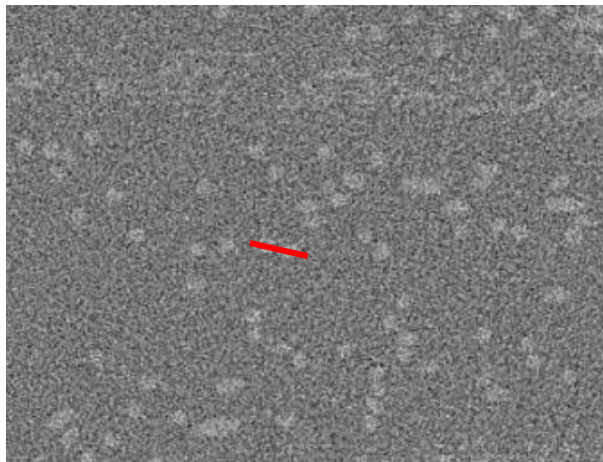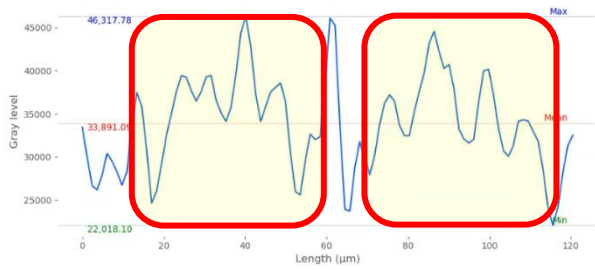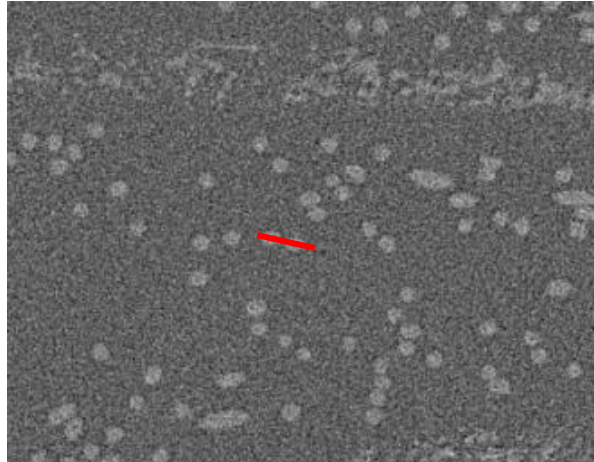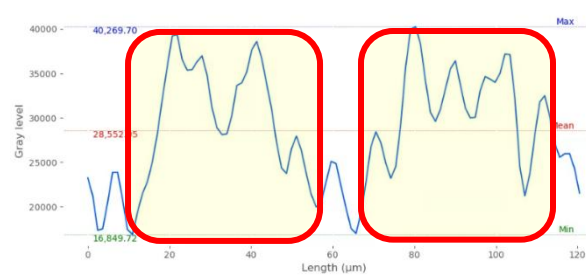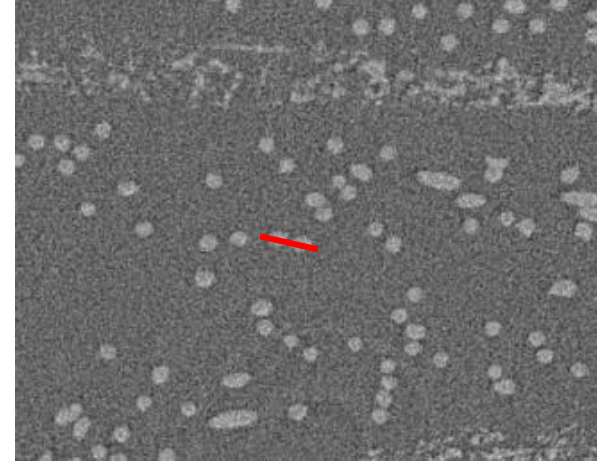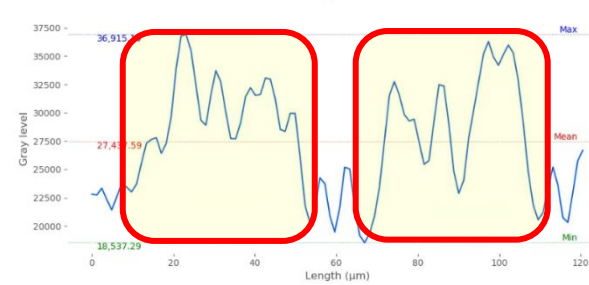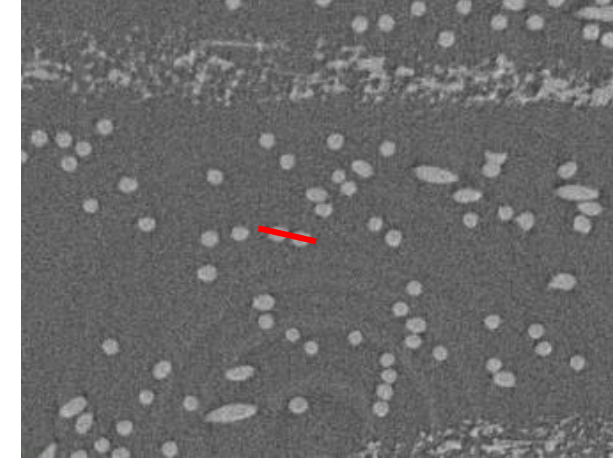
What is the optimal signal-to-noise?
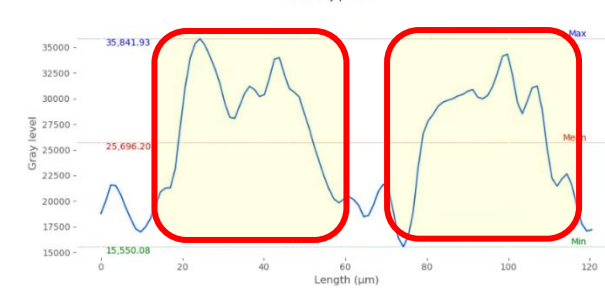
15 min   60 min   120 min   300 min

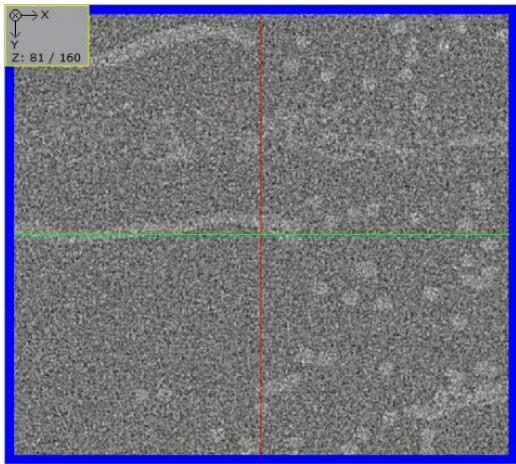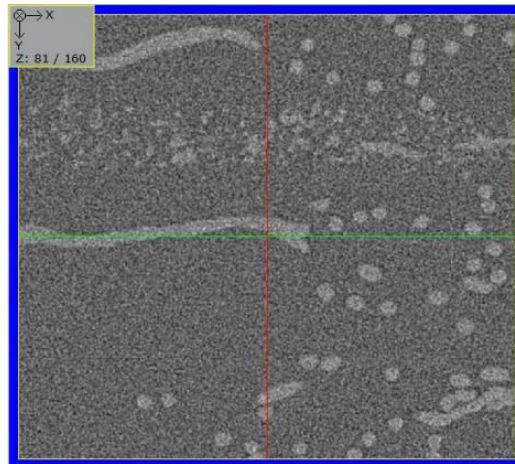# What is the optimal signal-to-noise?
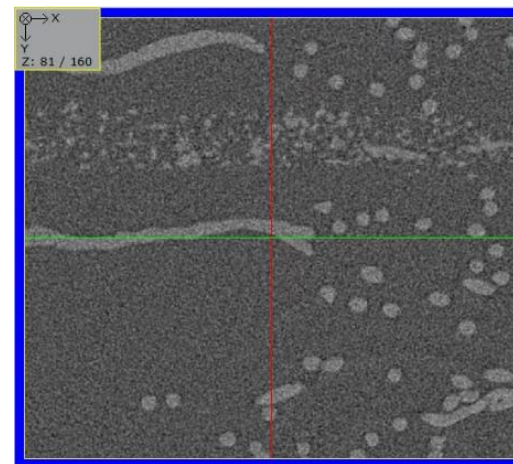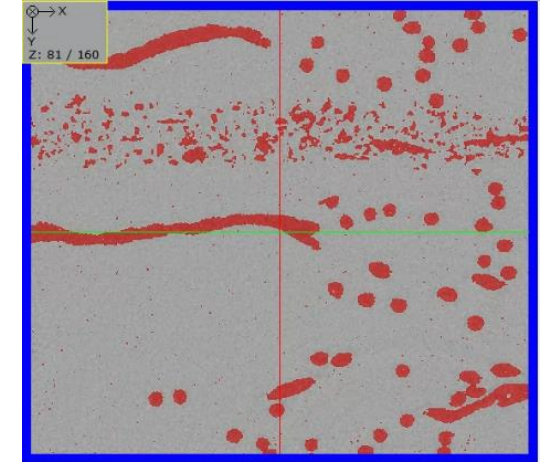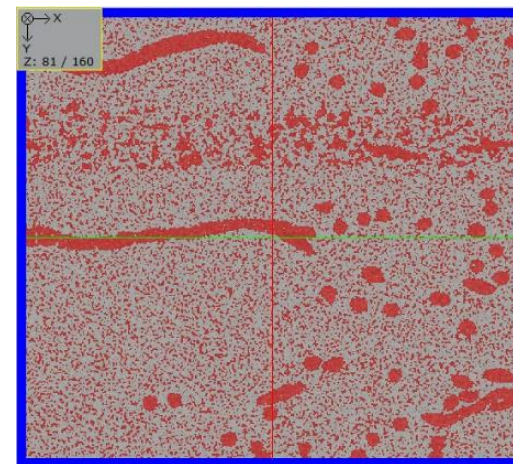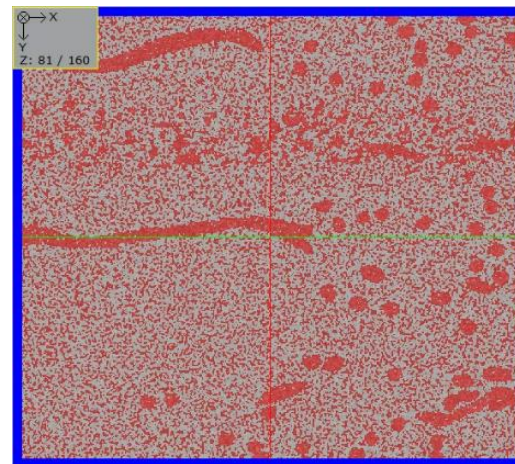
15 min   60 min   120 min   300 min

What is the optimal signal-to-noise?

15 min

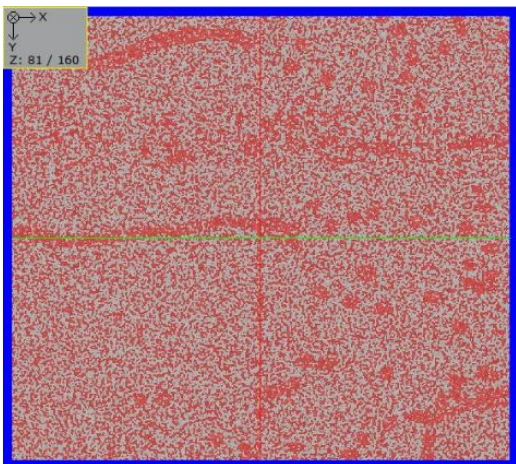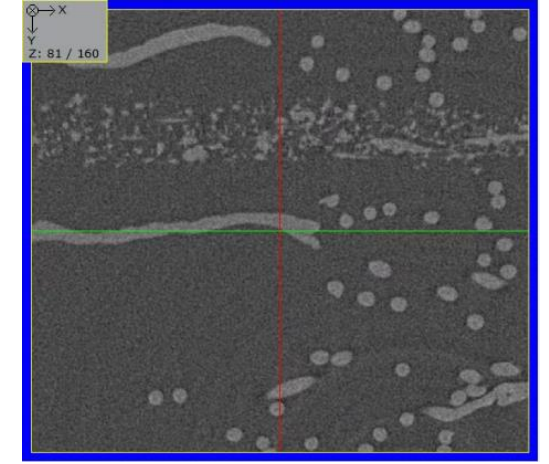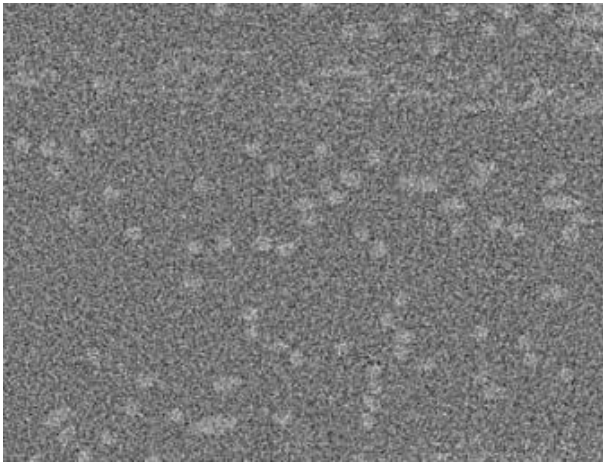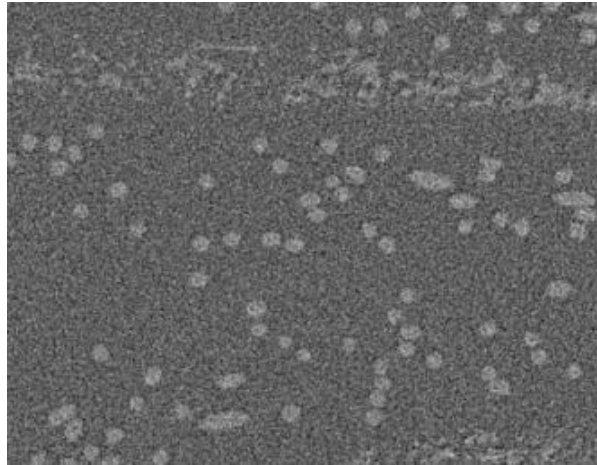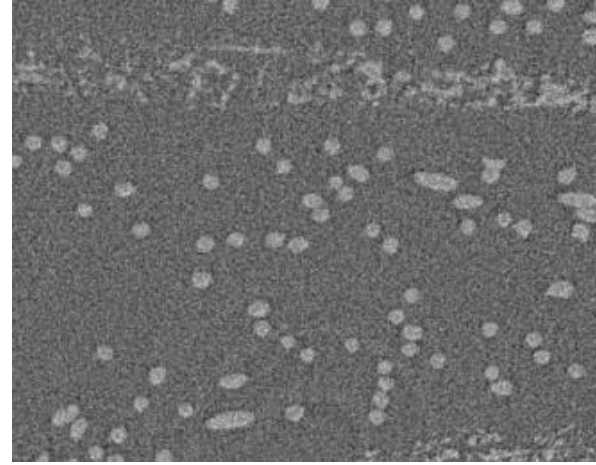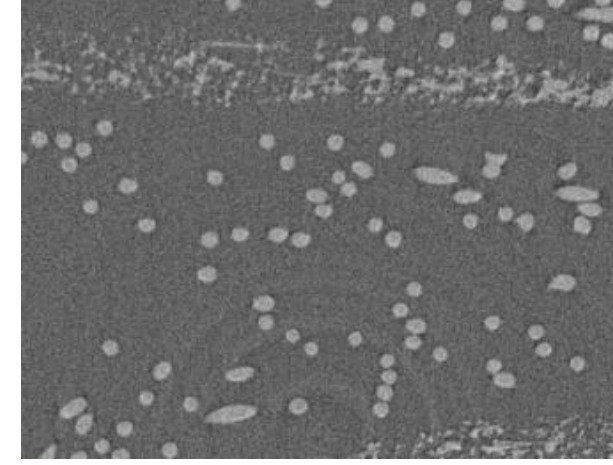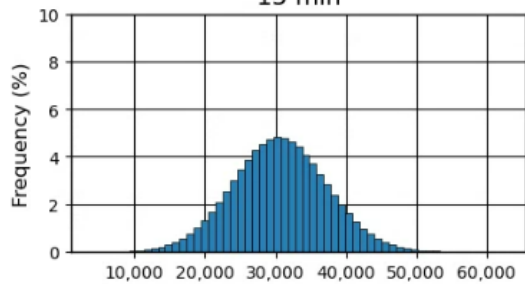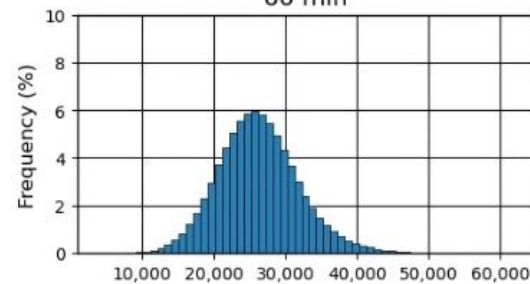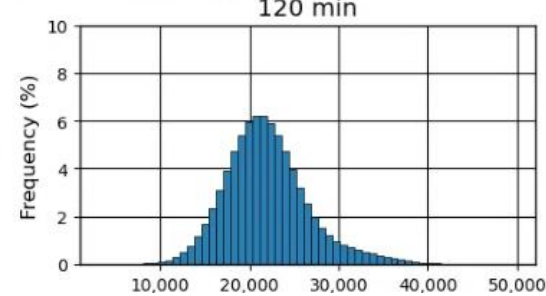60 min

120 min

300 min
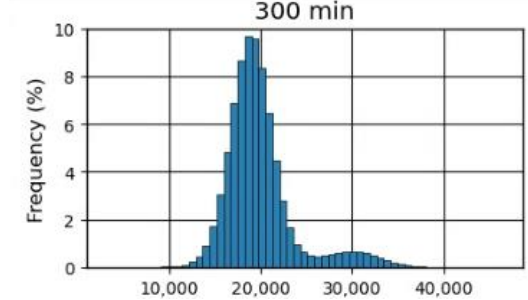
WHAT TYPE OF ANALYSES CAN WE DO FOR FILTER MEDIA?

FILTER MEDIA ANALYSIS

Porosity

Fiber diameter
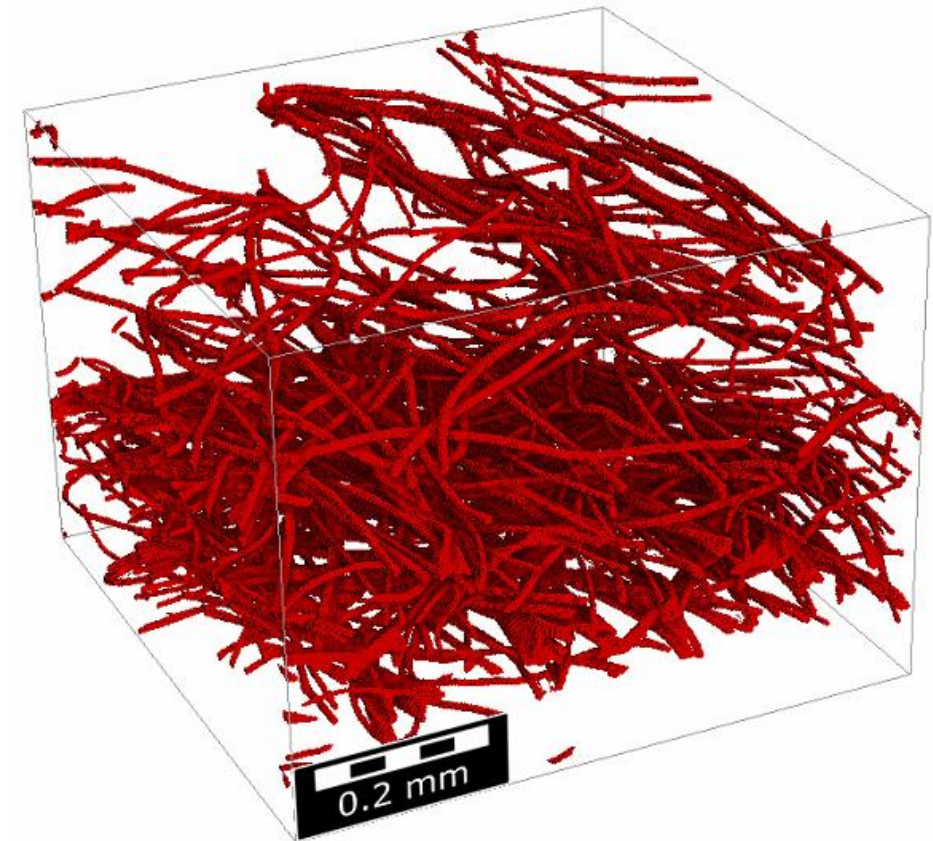
Fiber orientation

Fiber modelling

Initial pressure drop

Pore size distribution

Percolation paths

Filter efficiency

0.2 mm

FILTER MEDIA ANALYSIS

2
- Porosity
- Fiber diameter
- Fiber orientation
- Fiber modelling

3
- Initial pressure drop
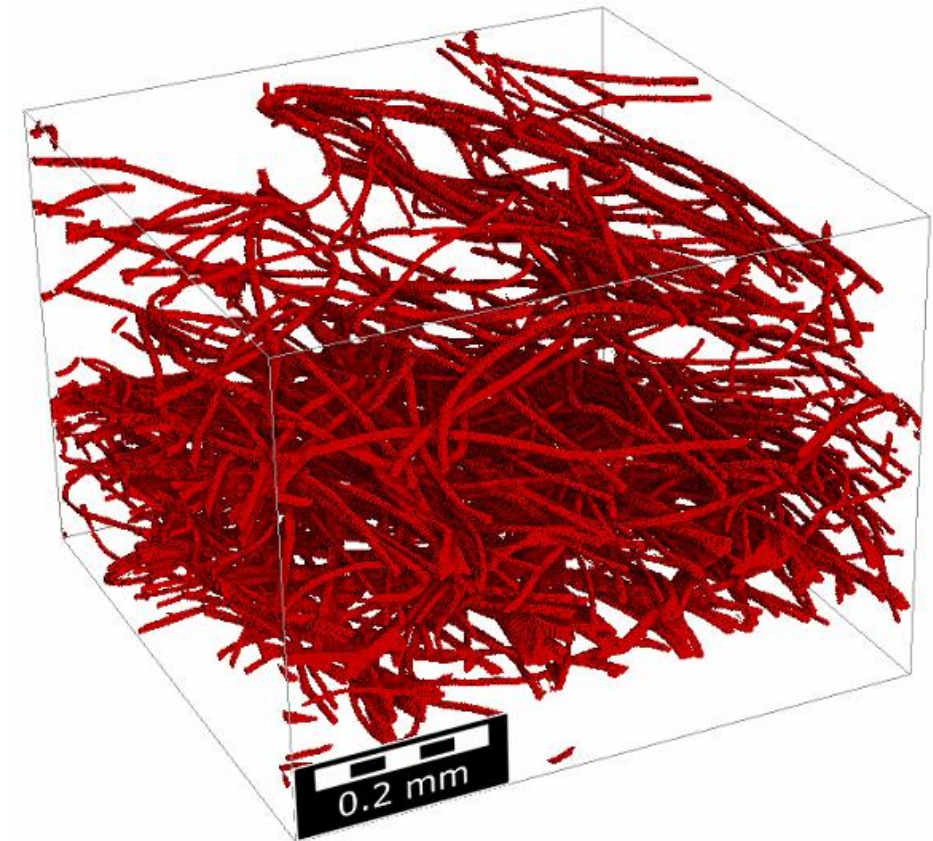- Pore size distribution
- Percolation paths
- Filter efficiency

0.2 mm

THINGS WE COVERED

- Filtration basics

- How to collect high-quality CT data for filter media

- How to evaluate image quality and suitability for fiber analysis

Q & A SESSION

We'll follow up with your questions.

Recording will be available tomorrow.

Register for the next workshop.

Next: Filtration Analysis
2. Segmentation & property analyses

November 16th Wednesday
11:00 am PDT / 2:00 pm EDT

THANK YOU FOR JOINING US
SEE YOU NEXT TIME