

New sectioning techniques for preparation of materials and biological samples for; TEM, SEM, 3D, Volume and Correlative Microscopy

Jeremy Rees

Europe Manager, RMC Products, Tucson, Arizona

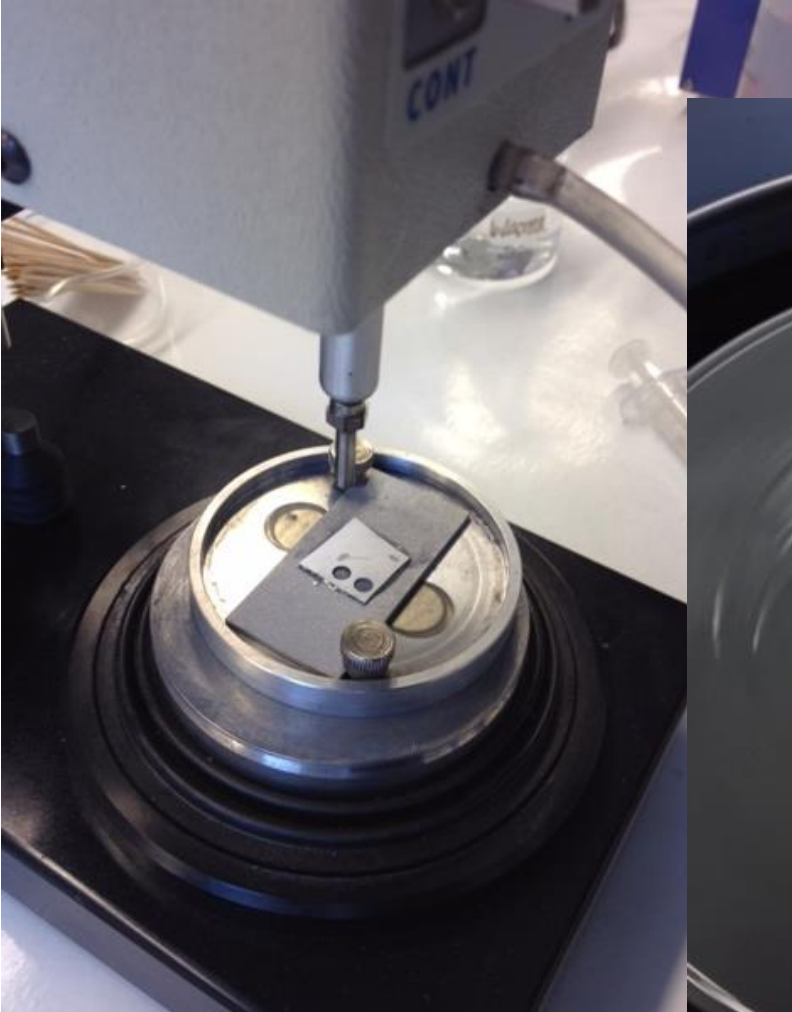
RMCTM
Boeckeler



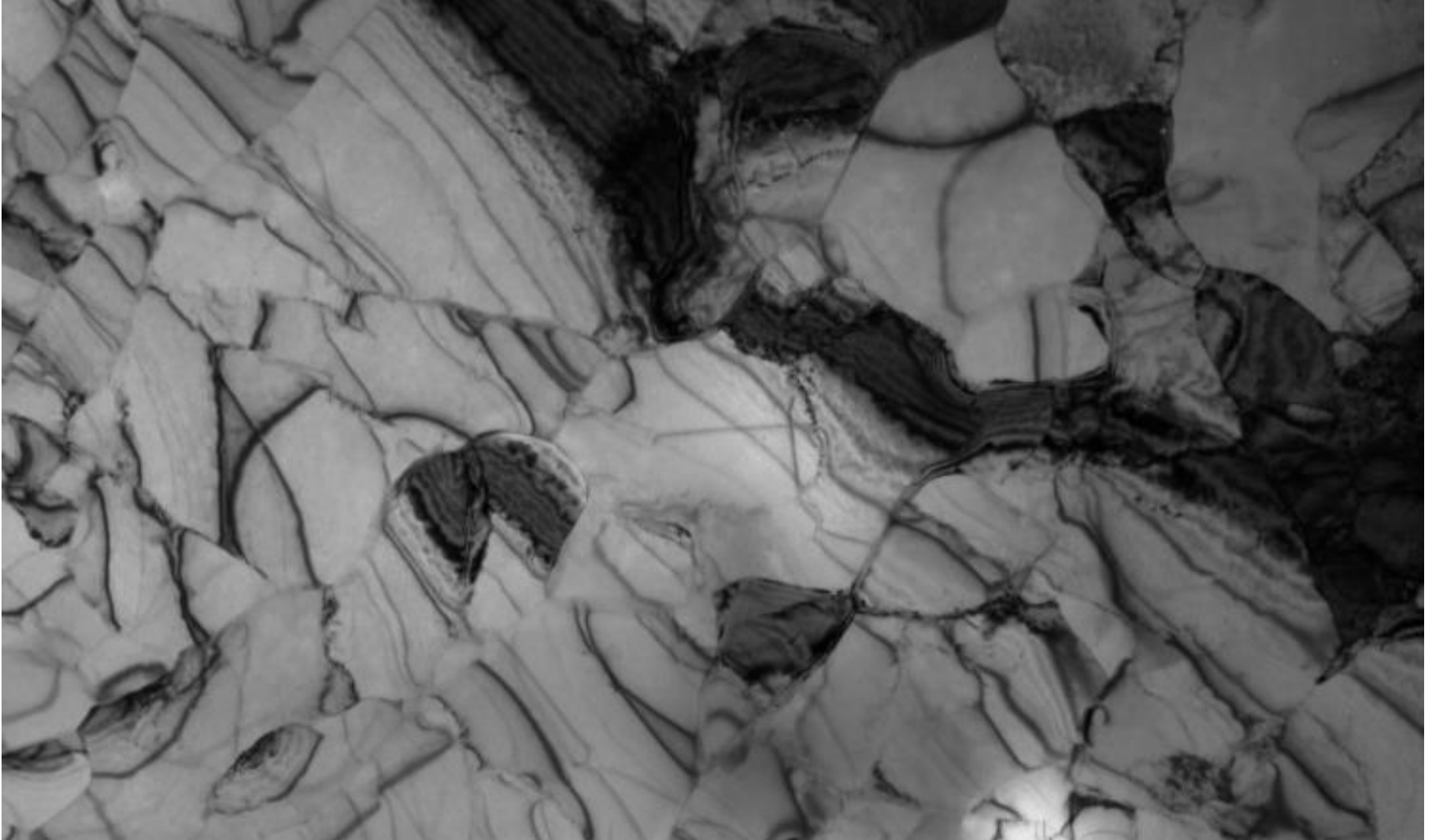
For materials there are **many ways of producing samples for EM.....**

- 1. Wet Powder Suspensions**
- 2. Dry Powder**
- 3. Mechanical polishing**
- 4. Etching**
- 5. Ion Beam Etching**
- 6. Electrochemical Thinning**
- 7. Replication**
- 8. Solvent casting**
- 9. UltraMicrotomy**

Mechanical Polishing



Electrochemical Etching/Thinning



Tenupol electropolished aluminium

These methods all have advantages and disadvantages....

Some;

quick + easy

time consuming

require high level skills

visualise the exterior only

involve chemicals

are difficult to control

introduce artefacts

implant ions

are very expensive.....

UltraMicrotomy

The use of a mechanical device to cut a thin section

Can be used for polymers, metals, ceramics and biological samples

Glass or diamond knives are used to cut ultrathin sections

UltraMicrotomy

Uniform and Chemically Benign Technique

No;

Polishing Compound

Polishing Scratches

Chemical Etching

Implantation

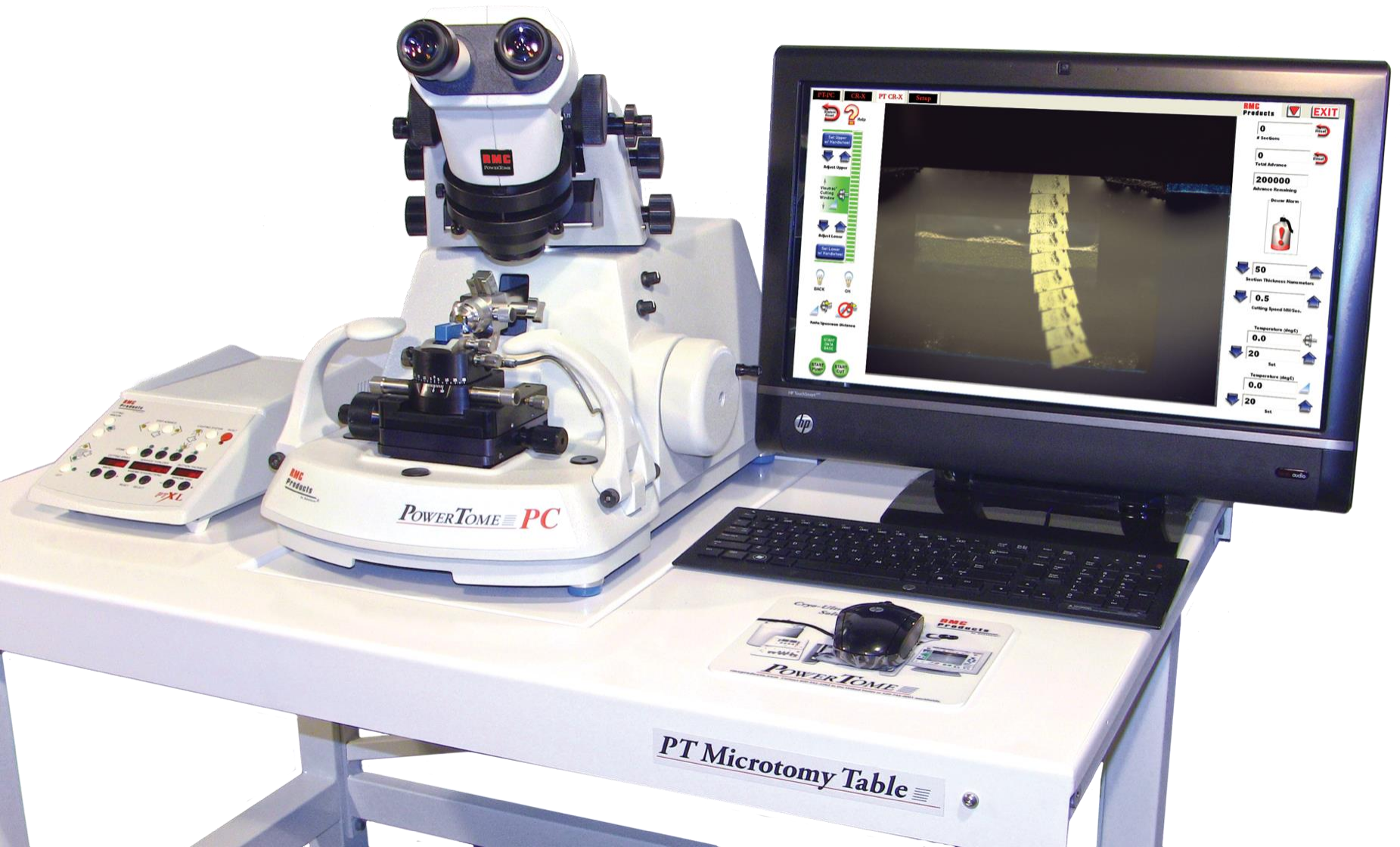
Temperature Effects

Uniform Thickness

Large Area

Select Sample Location

RMC PowerTome PC



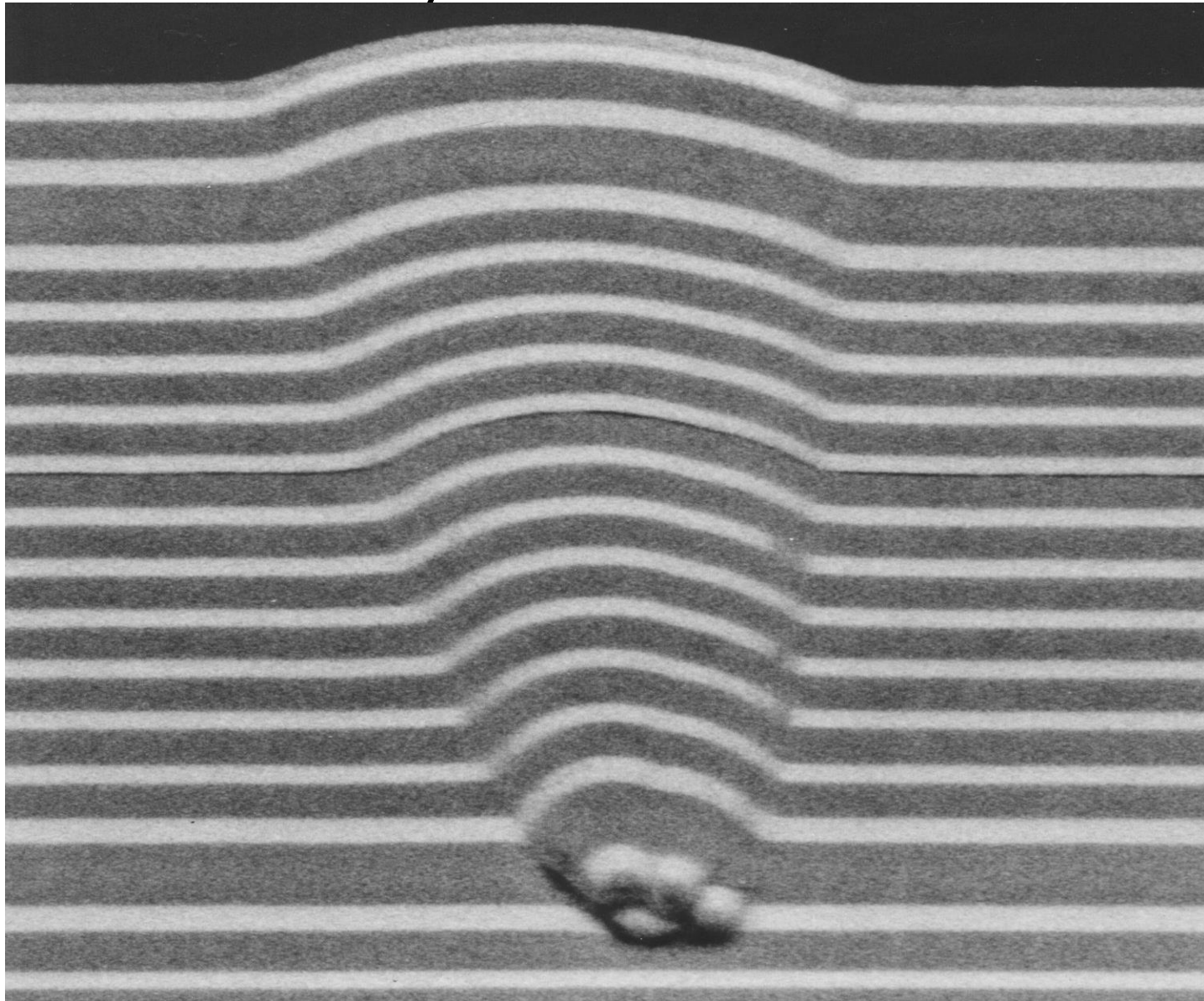
Ultramicrotomy

Uniform and Chemically Benign Technique

Ultramicrotomy produces thin EM sections for TEM, STEM and SEM

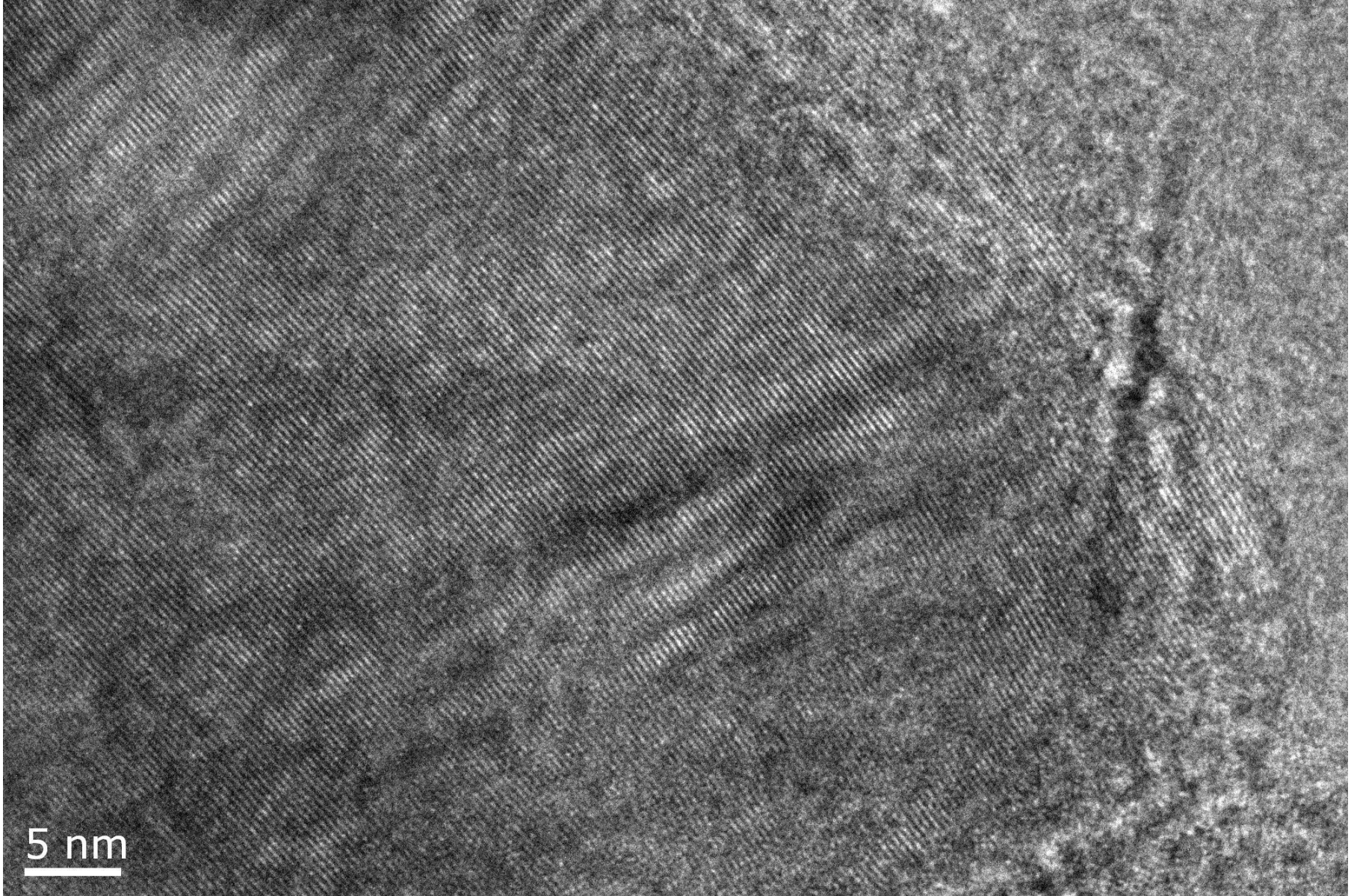
Routinely used to cross-section polymers, biological tissue, metals, semiconductors, and glass, plus many others....

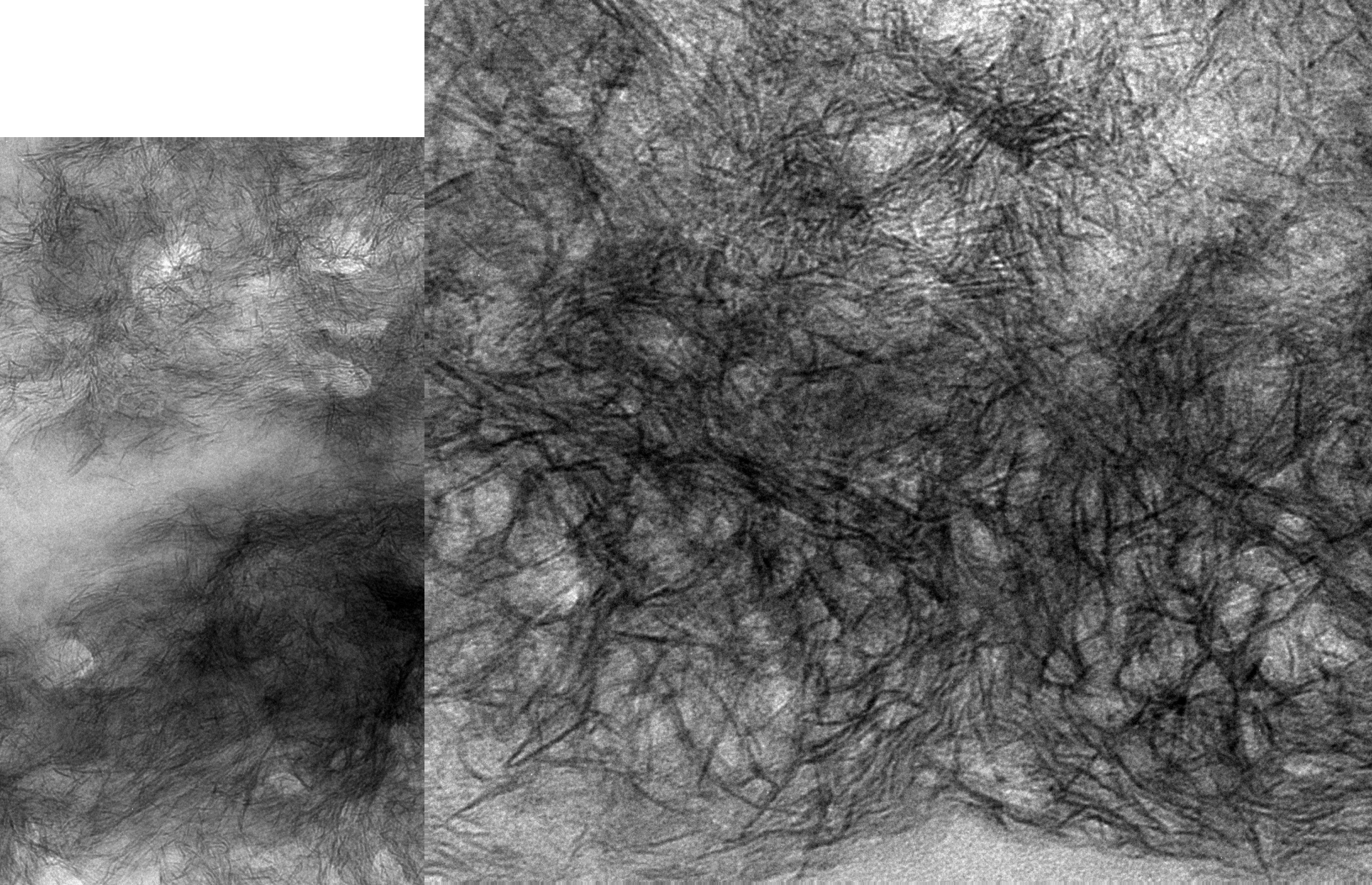
Multilayer Semiconductor



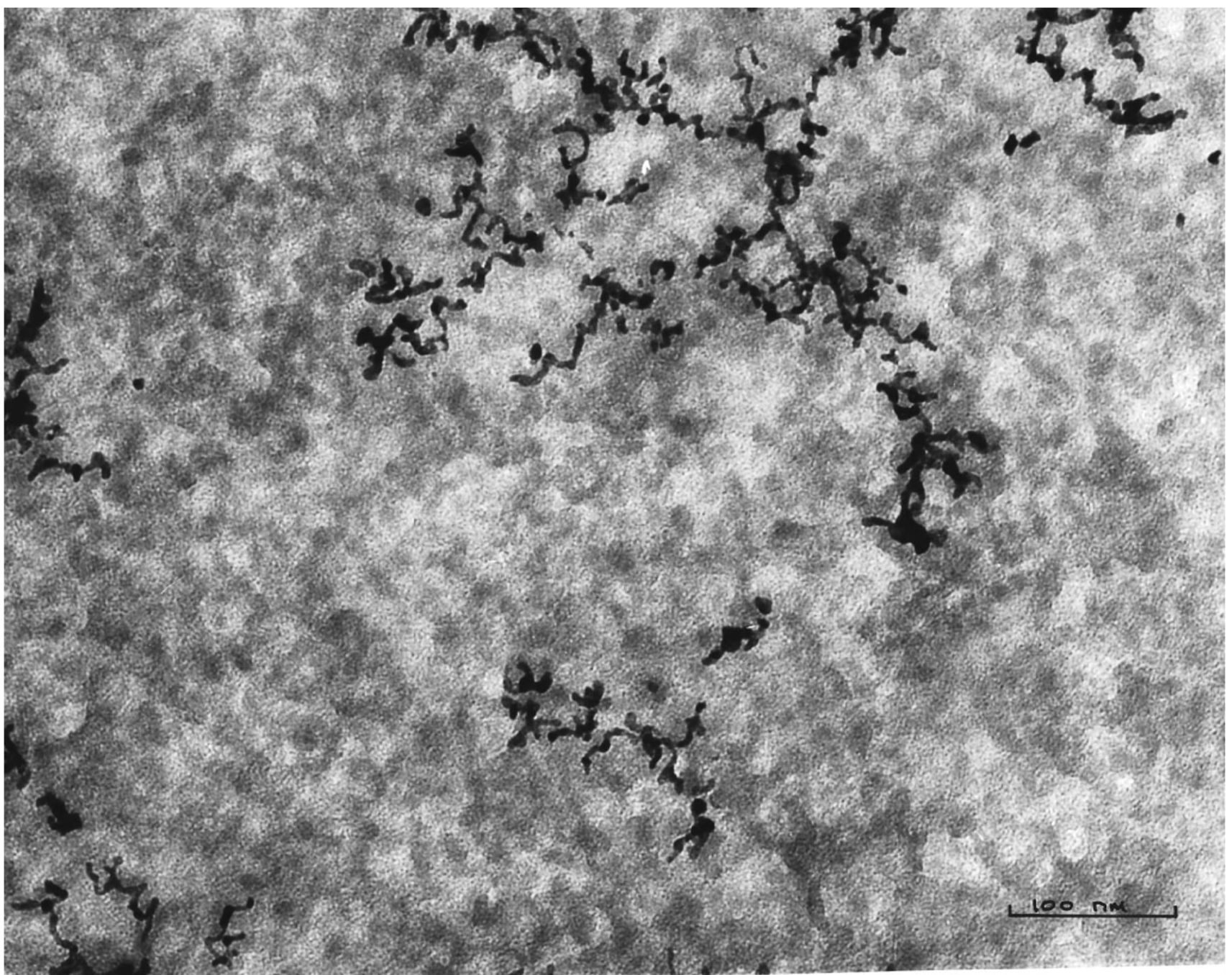
Coating defect in an IR multilayer stack.
(Courtesy Phil Swab, Unity Semiconductor)

Si Wafer

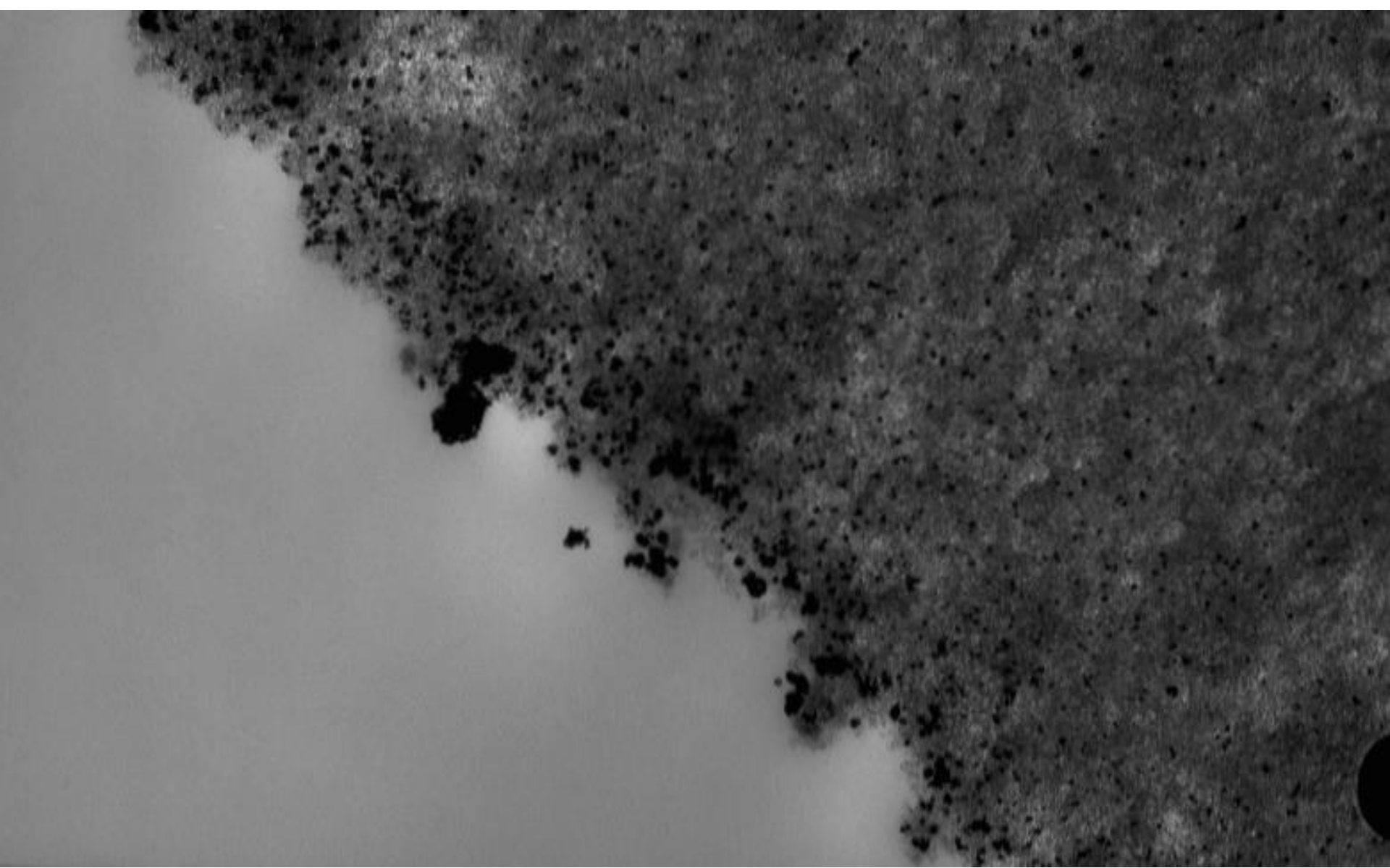




Hydroxyapatite – high magnification



Platinum catalyst on SiO₂

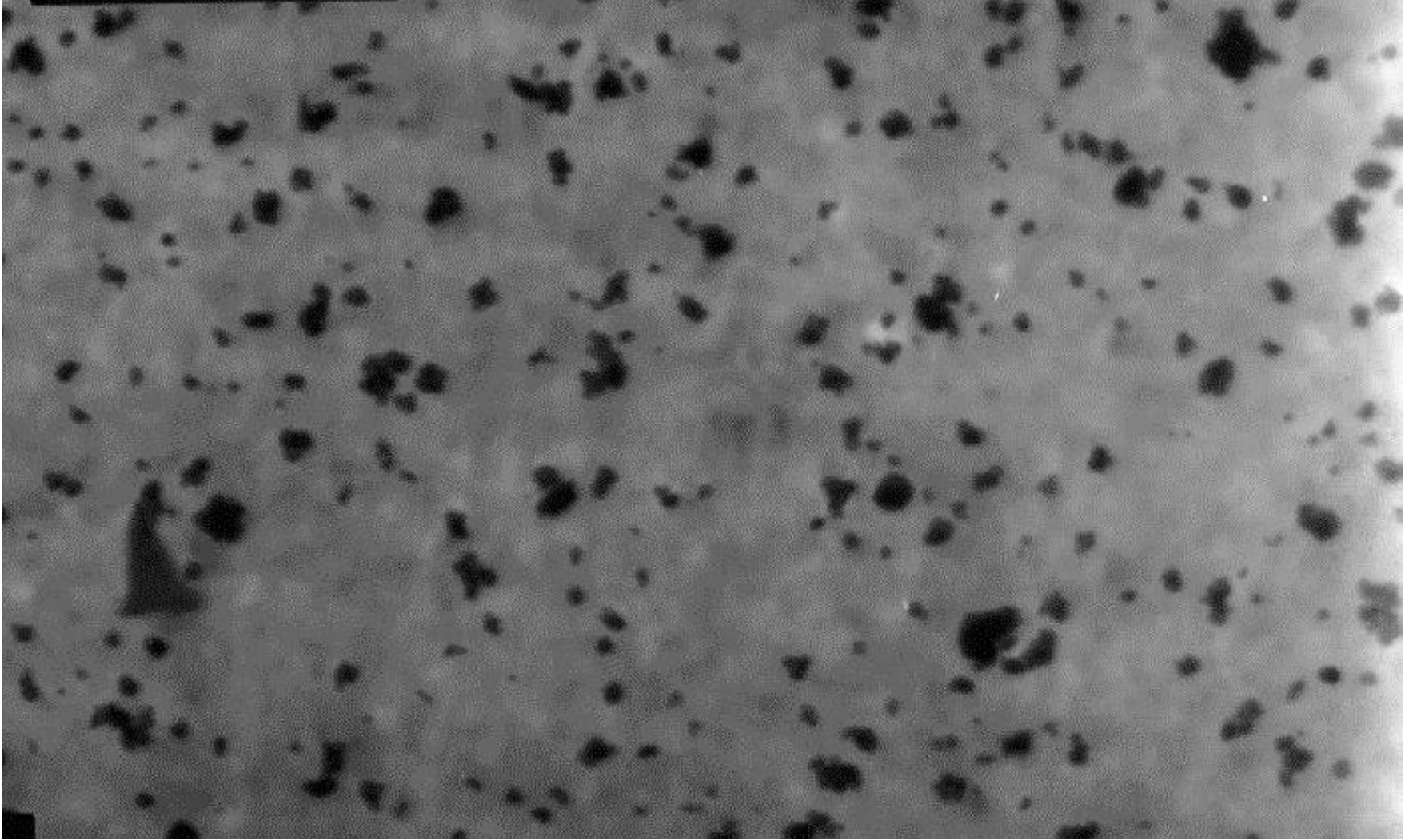


Gold/palladium nanoparticles on TiO₂

Cryoultramicrotomy

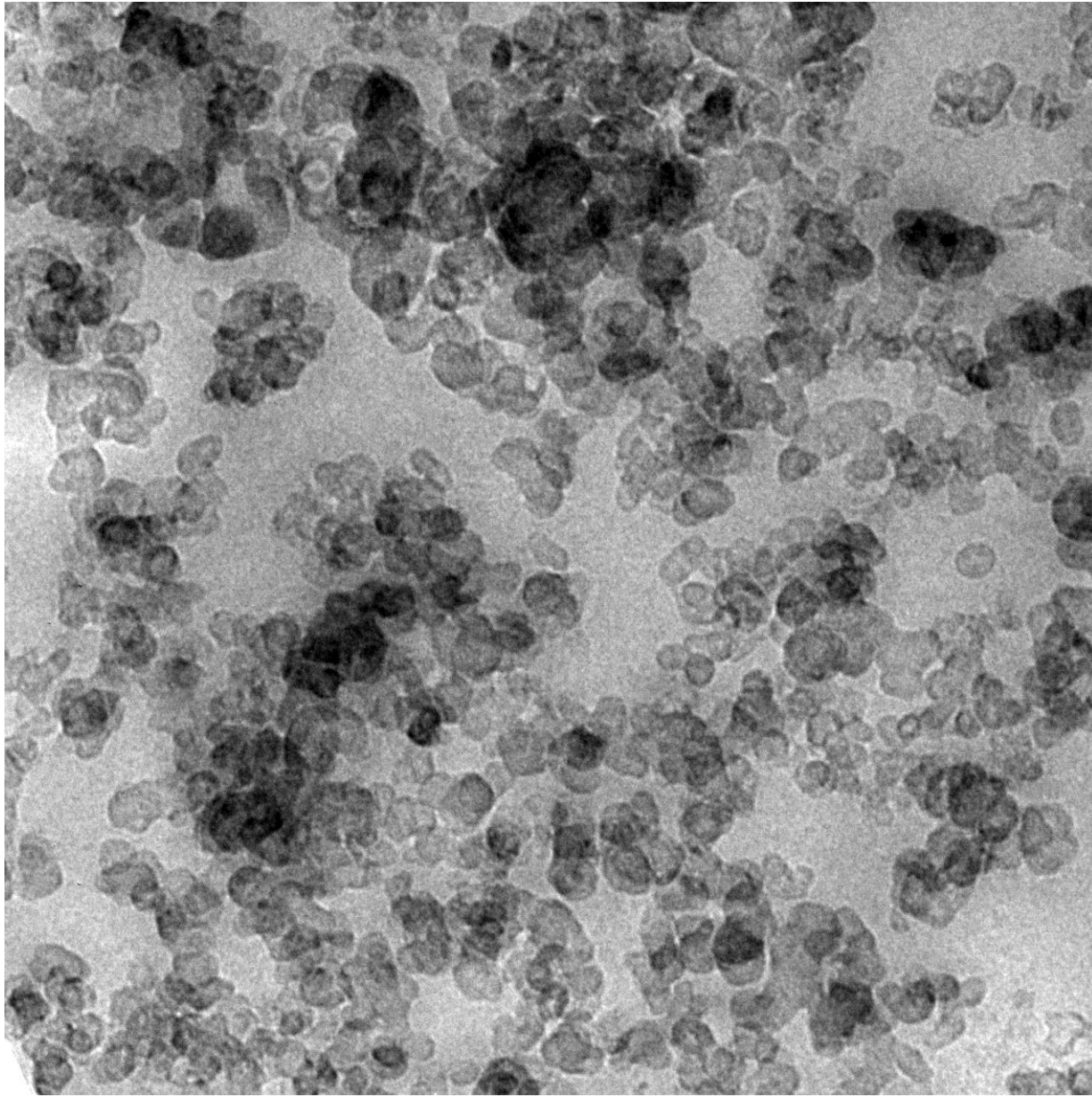
If a material cannot be cut at room temperature it may be cut at lower temperatures.

Sectioning of polymers

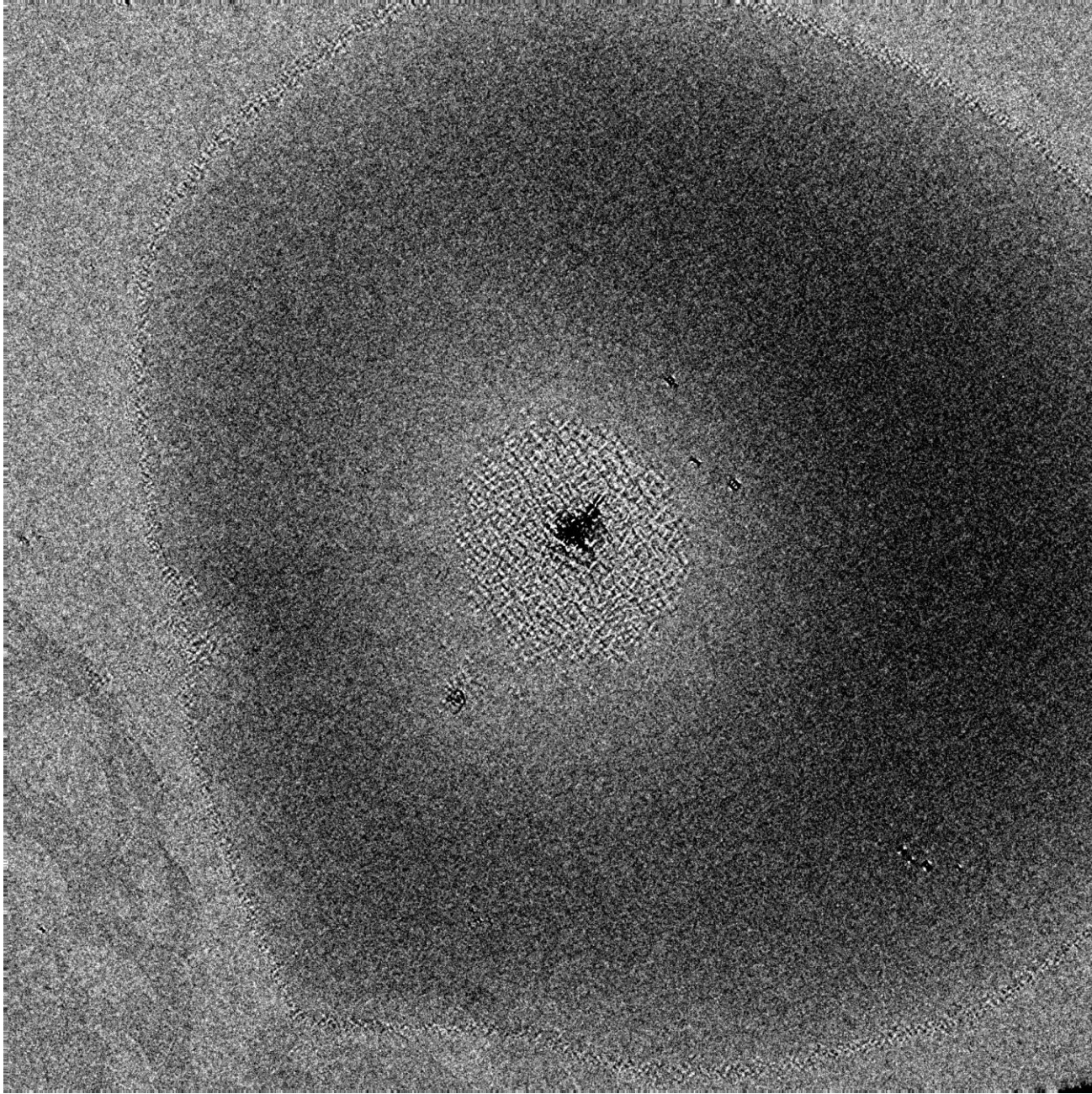


Cryo-section of TiO_2 in polyethylene (-150°C)

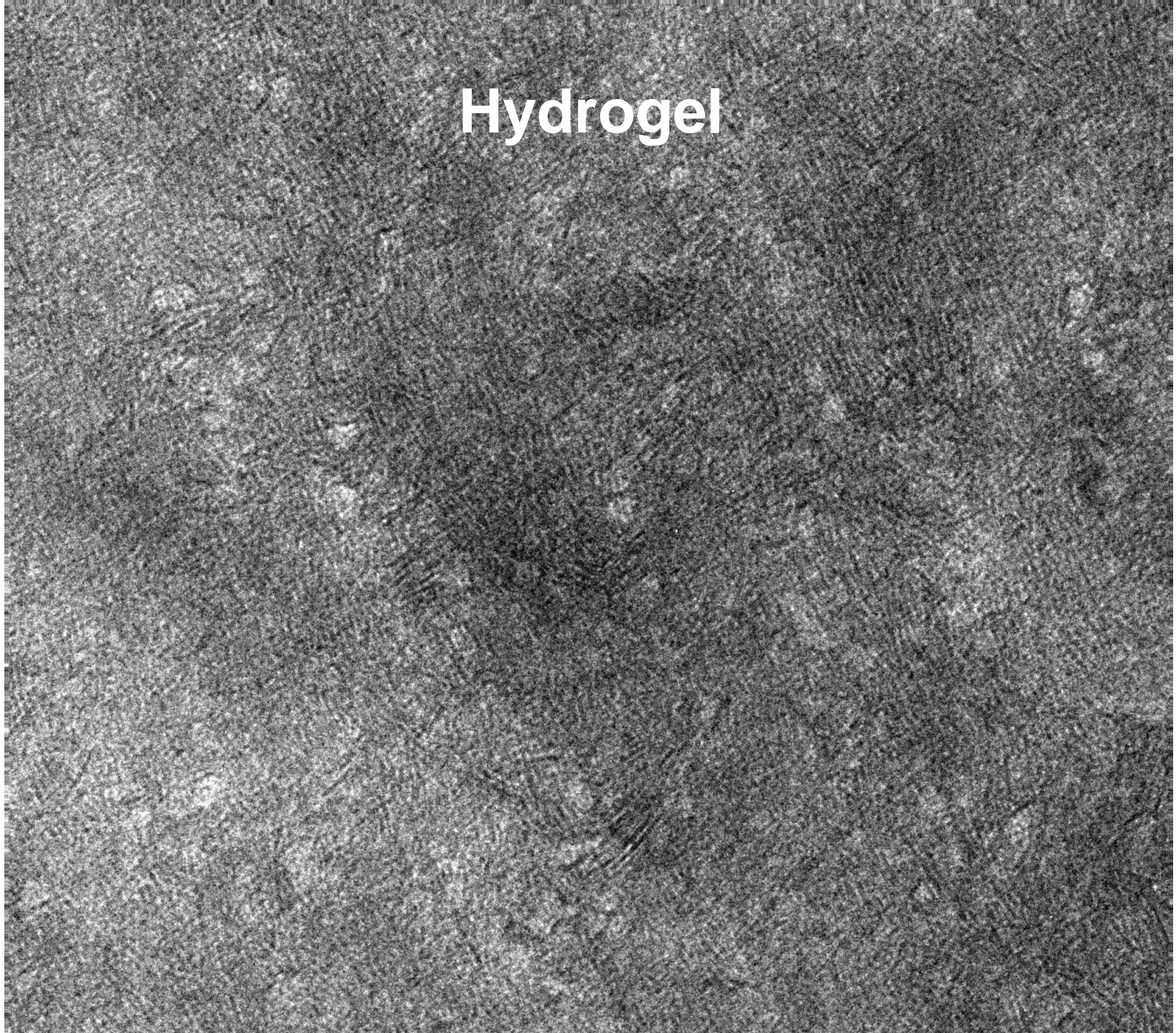
Natural Rubber with 50% carbon black



Starch Grain (cryo sectioned, unstained)

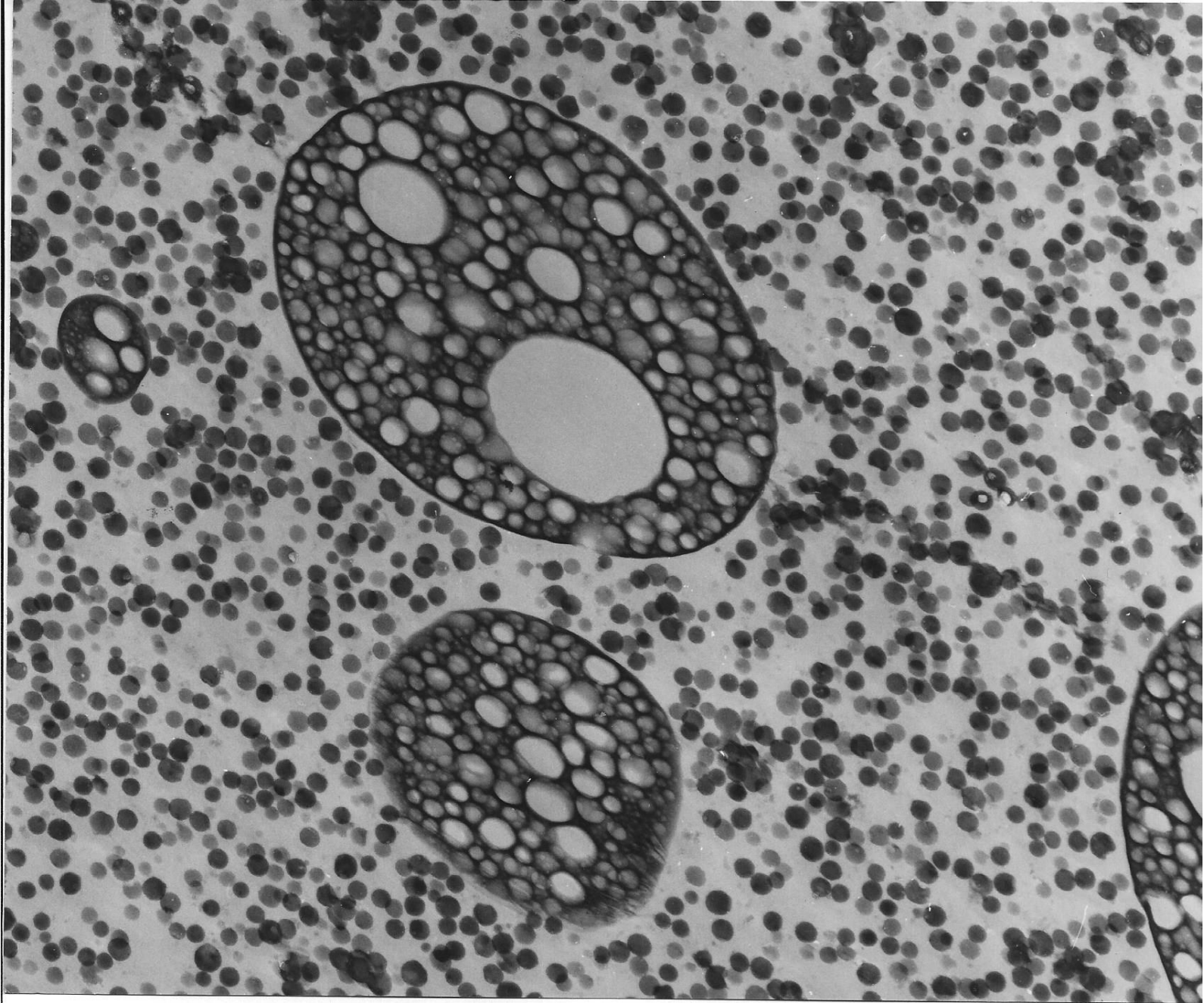


Hydrogel



Sectioning of polymers

Polymers can be stained and hardened by using heavy metal oxides such as Osmium tetroxide or Lanthanum oxide



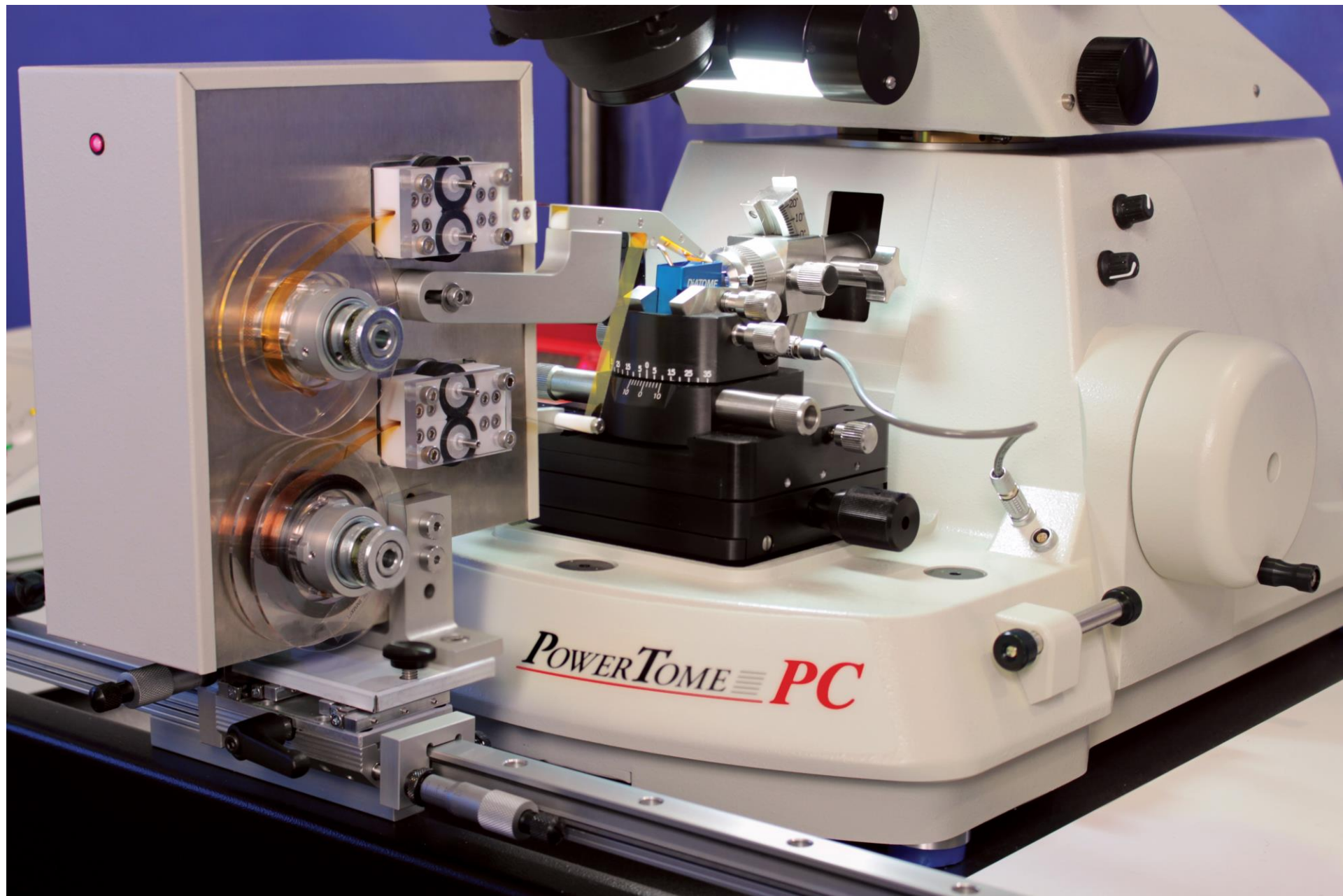
Osmium tetroxide block stained ABS

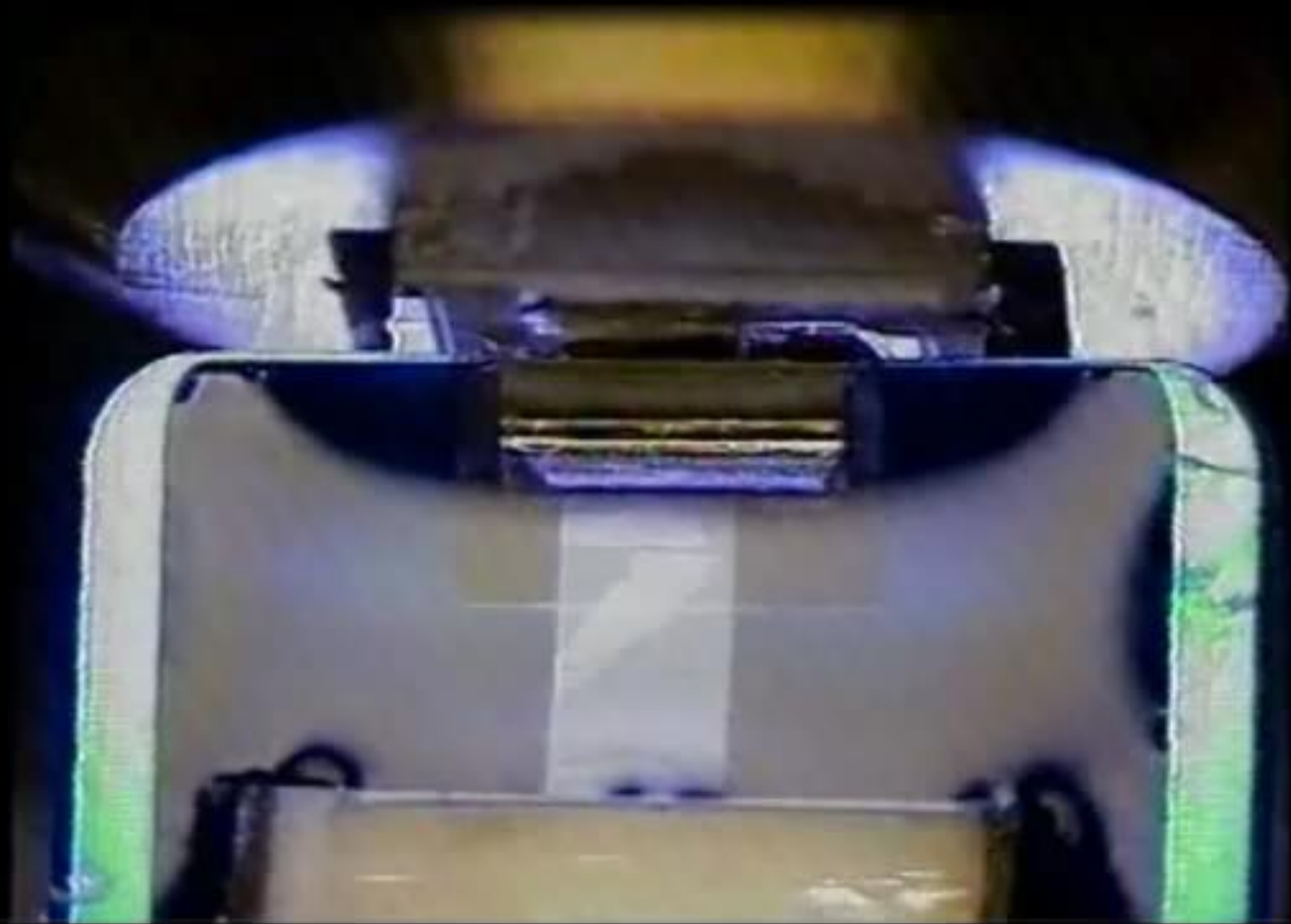
Future Directions

**Automation of ultramicrotomy for 3D or
“volume microscopy”**

**Thousands of serial sections cut
automatically and imaged inside an FEG
SEM**

RMC ATUMtome





ATUM tome

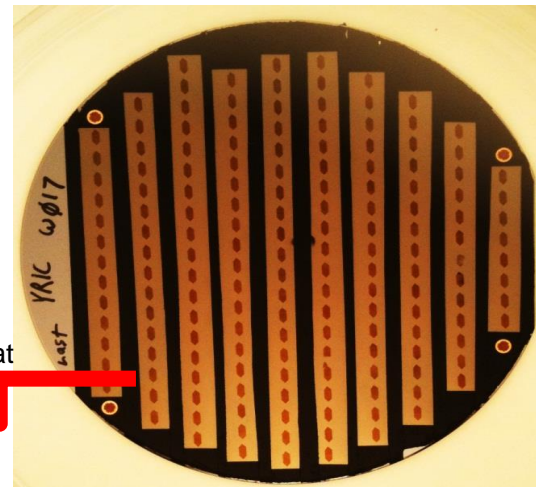
Wafer Fabrication Workflow

Collect Sections on Tape



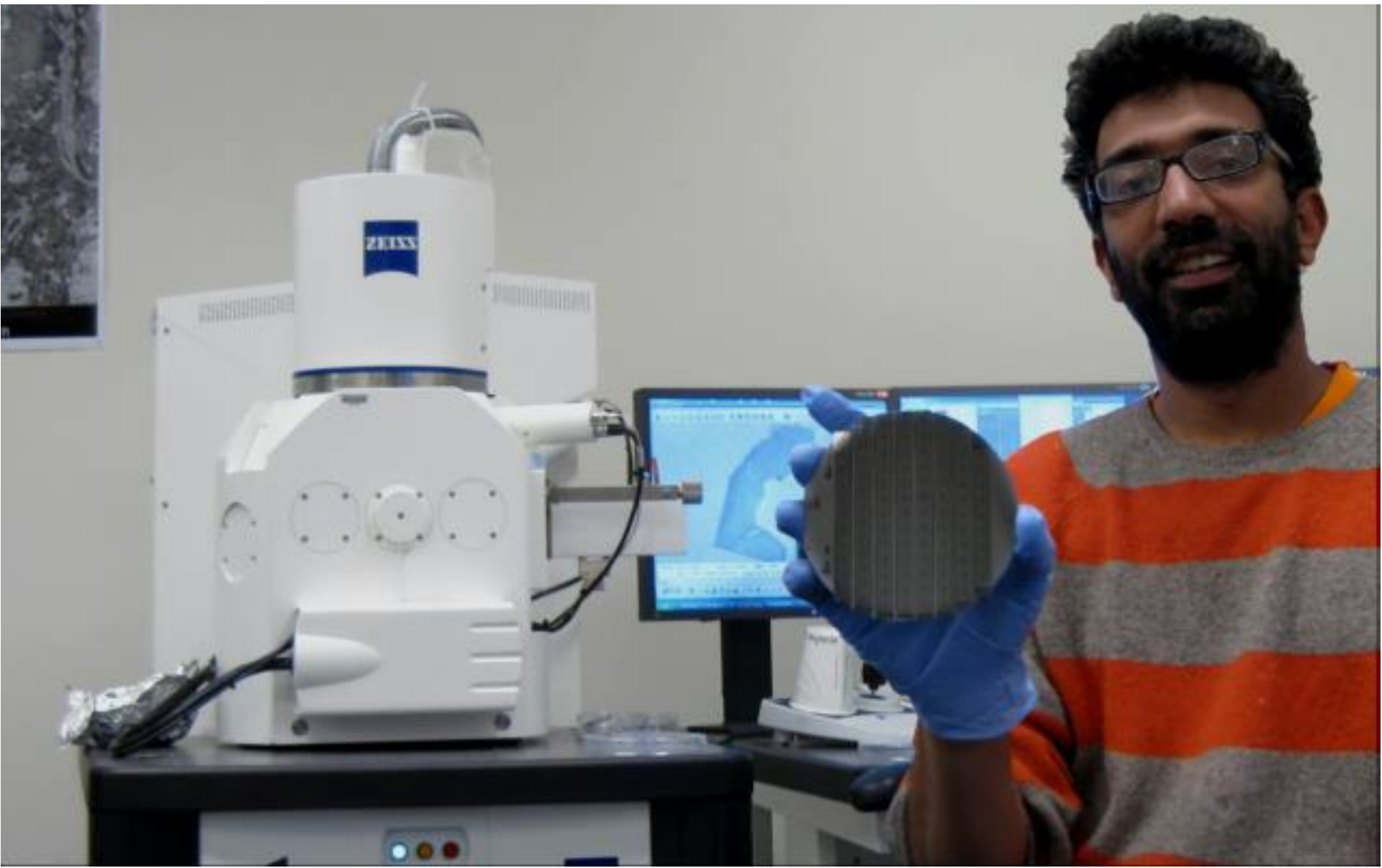
Populate Wafer

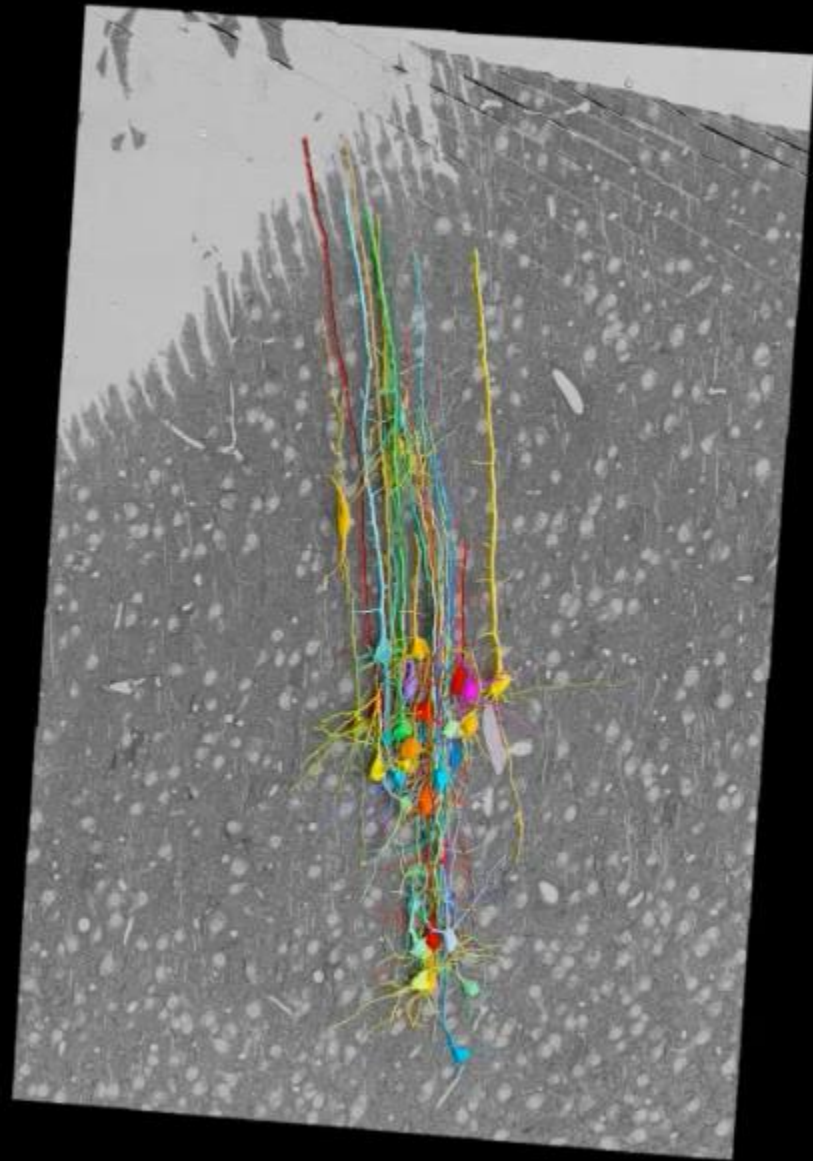
- Cut into strips and adhere to surface of 4 inch diameter silicon wafer
- Add fiducials
- Image as-is or carbon coat

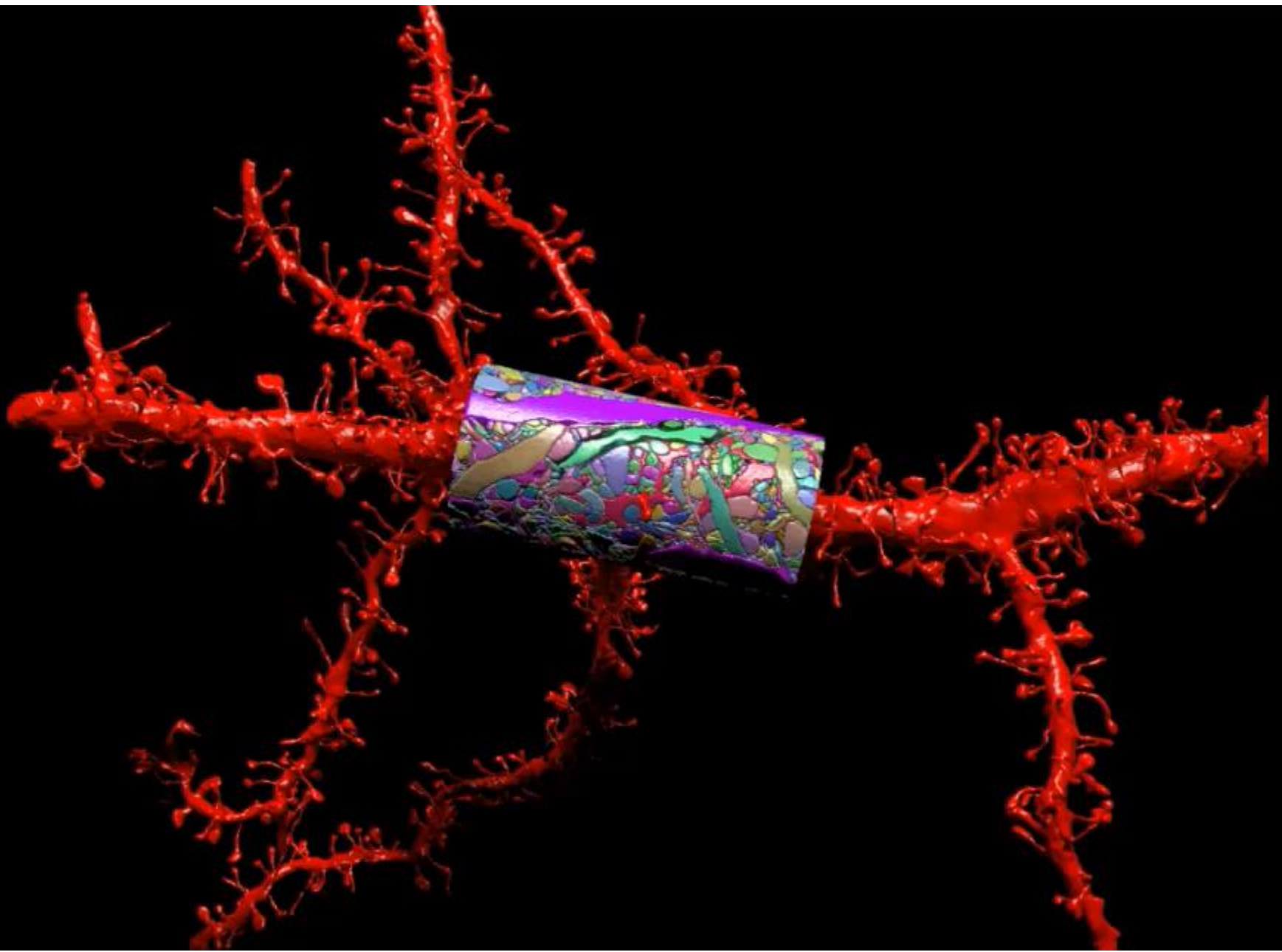


Repeat









Future Directions

**ASH Advanced Substrate Holder for
Correlative Light and Electron Microscopy**

**Serial sections cut and imaged in a light
microscope, immunostained and/or
viewed inside a FEG SEM**

Videos courtesy of;

RMC

Dr Jeff Lichtmann (Harvard University)

Carl Zeiss



Thankyou for your attention

