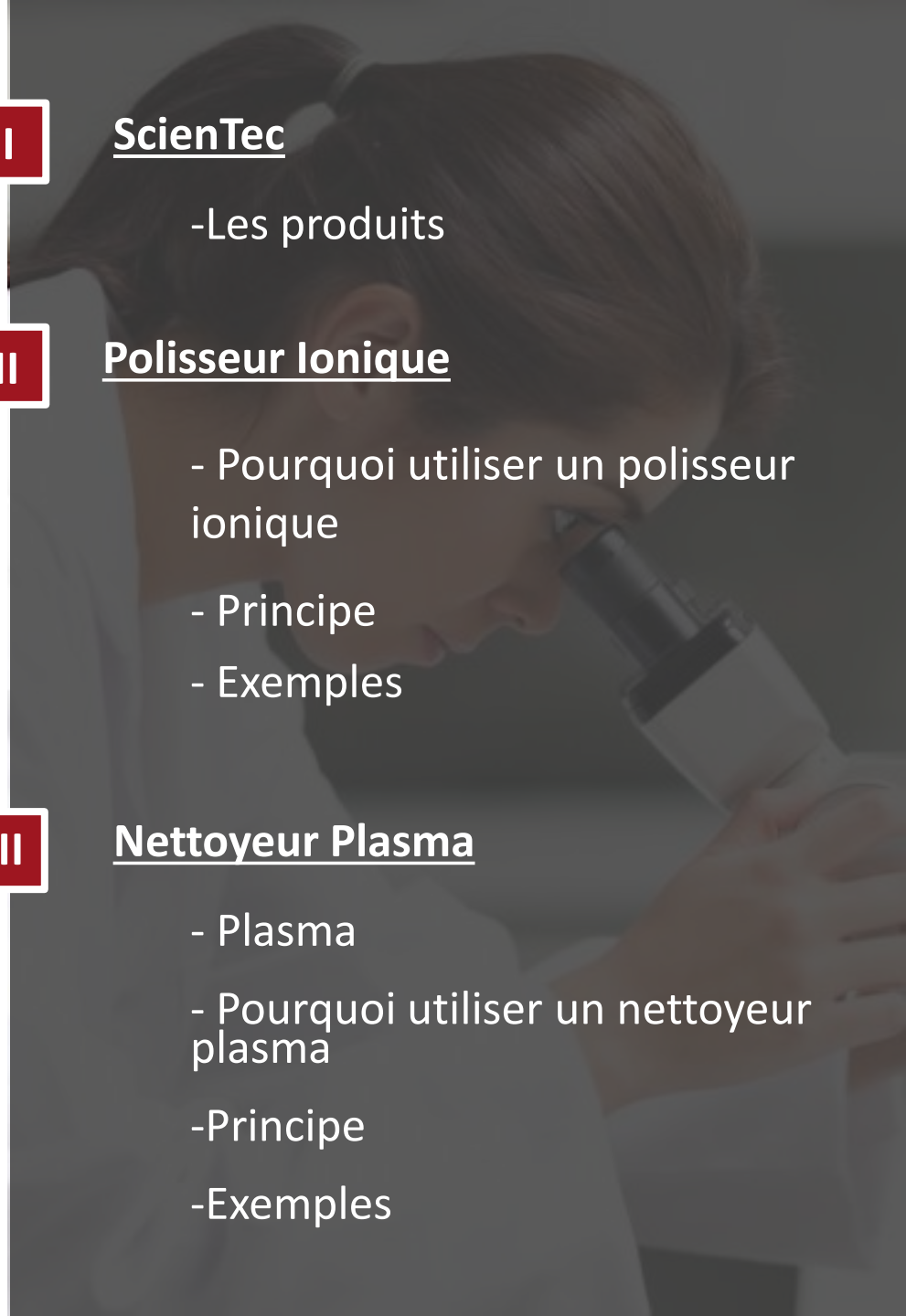
ScienTec
PRESENTATION

Company specializes in the distribution of rigorously selected scientific equipments.



I **ScienTec**

-Les produits

II **Polisseur Ionique**

- Pourquoi utiliser un polisseur ionique
- Principe
- Exemples

III **Nettoyeur Plasma**

- Plasma
- Pourquoi utiliser un nettoyeur plasma
-Principe
-Exemples

I. About ScienTec

History

Founded on 1999

Distribution & support

Surface analysis

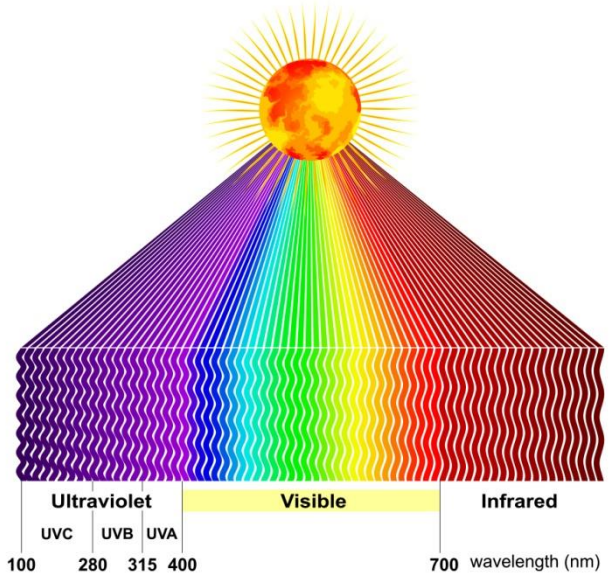
Radiometry & colorimetry

Scientific equipments

Konica Minolta

Konica Minolta is a world leader in its field, it's researches, designs, engineers and manufactures advanced photonic systems, components and instrumentation for applications in the Aerospace & Defense, Industrial, Life Sciences and Scientific Research sectors.

KONICA MINOLTA



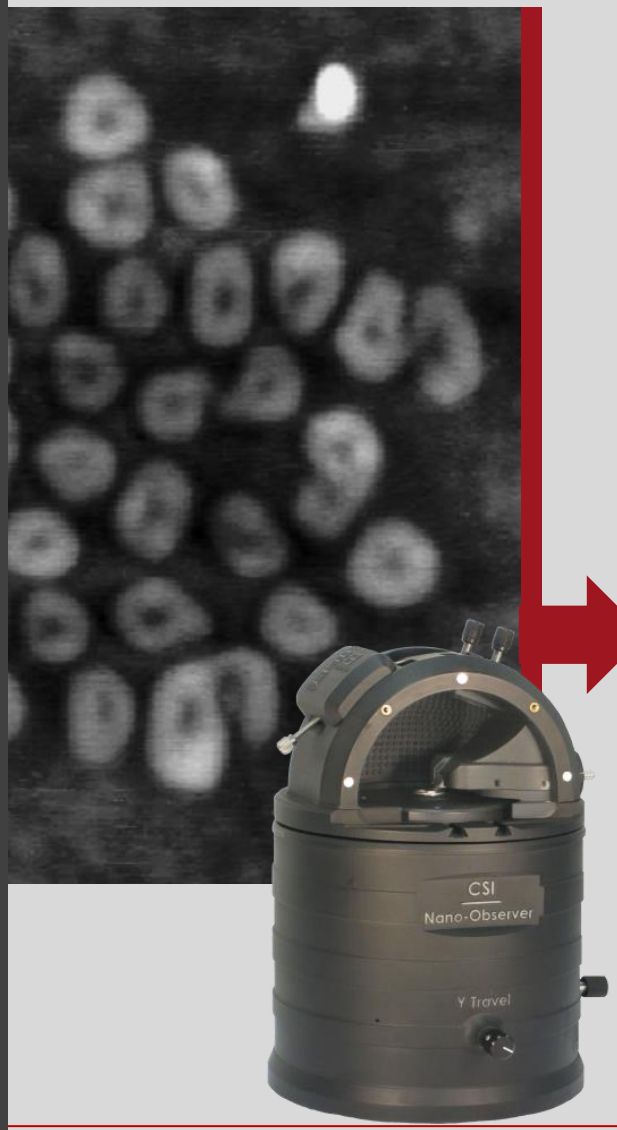
LIGHTING MEASUREMENTS

- **Spectroradiometer**
- Luminancemeter
- Videophotometer
- Luxmeter

Concept Scientific Instruments

CSI, manufacturer specializes in the conception of Atomic Force Microscope and offers many solutions in AFM as Nano-Observer, **the best price/performance AFM** and recently **the best AFM electrical measurements package** with sMIM system combined with ResiScope™ and HD-KFM™ modes.

CSI Concept Scientific Instruments



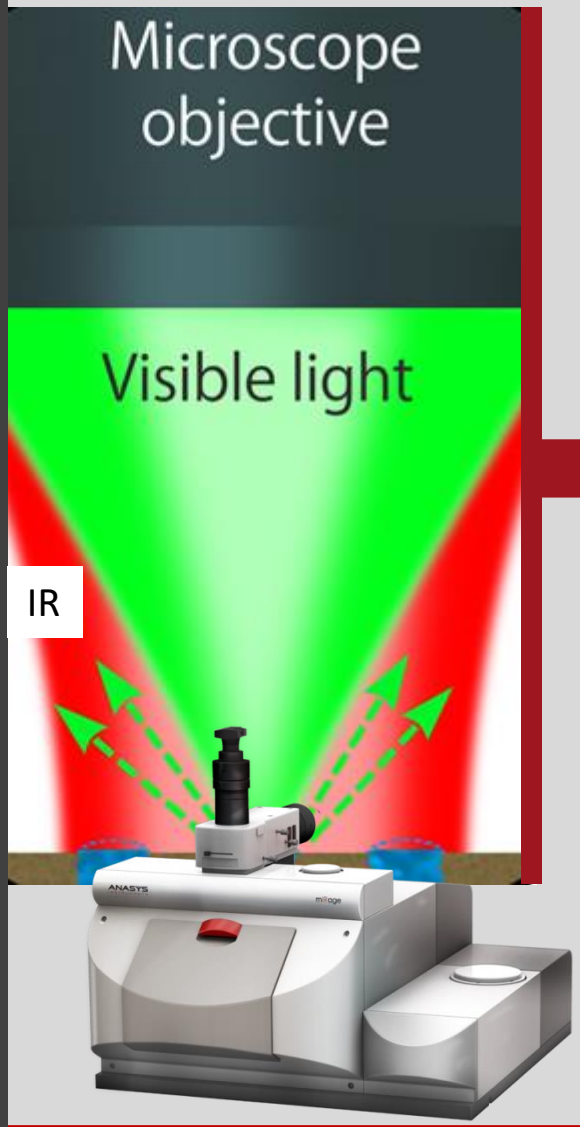
ATOMIC FORCE MICROSCOPE

Best cost effective solution

- Easy to use
- Multiple modes
- **Advanced electrical modes** :
  - -HD-KFM, **ResiScope**, Soft ResiScope
- **Environments** :
  - -liquid, temperature, peltier, gas…
- **Material characterization, Polymer science, Semiconductor Soft sample, Biology**

Photothermal Spectroscopy

Photothermal Spectroscopy Corp is the pioneer in sub-micron IR spectroscopy for materials, polymer and life science research.



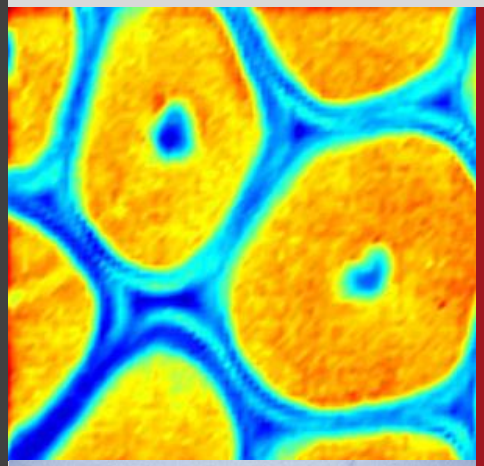
IR & RAMAN SPECTROSCOPY

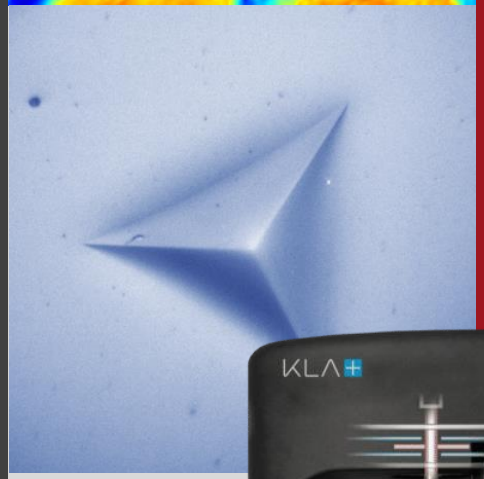
-A fast and easy to use non-contact optical technique
-Eliminates need for thin sections
-Transmission FTIR quality spectra in reflection mode
- Mirage covers a broad applications range
-**Polymeric and non-polymeric materials, life science, complex pharmaceutical samples and micro-electronics contamination…**

PHOTOTHERMAL SPECTROSCOPY CORP

KLA

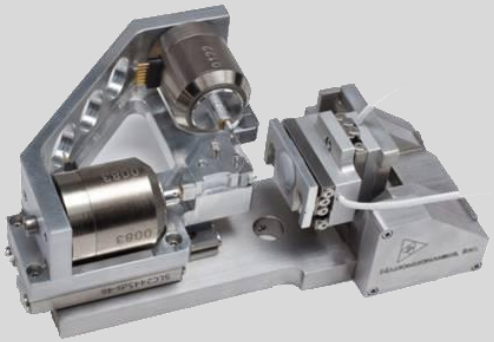
The KLA-Tencor series of benchtop stylus and optical surface profilometers offer the most complete range of stylus surface measurement features to meet the surface measurement needs of the engineering and research communities.





NANOINDENTERS

- Hardness
- Easticity
- Temperature
- Imaging
- Miltiple environments
- **Metals, ceramics, ultra thin-film, paints, plastics, chemical, MEMs, fibrous…**



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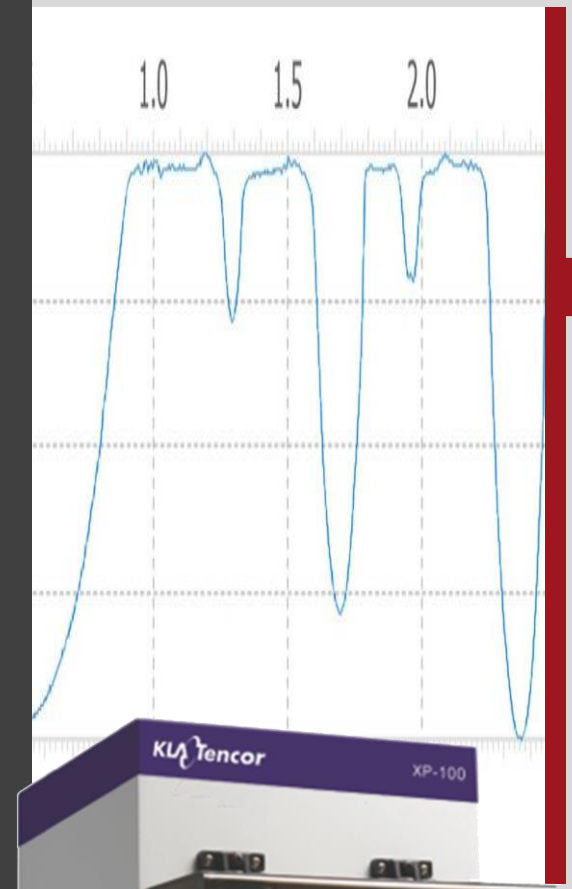

MECHANICAL PROFILERS

-Industries & Research

- Complete range

-**Step Height, Roughness and Texture, Bow, Shape and Form, semiconductors, data storage, MEMS, optoelectronics**

KLA, Filmetrics, LynceeTec

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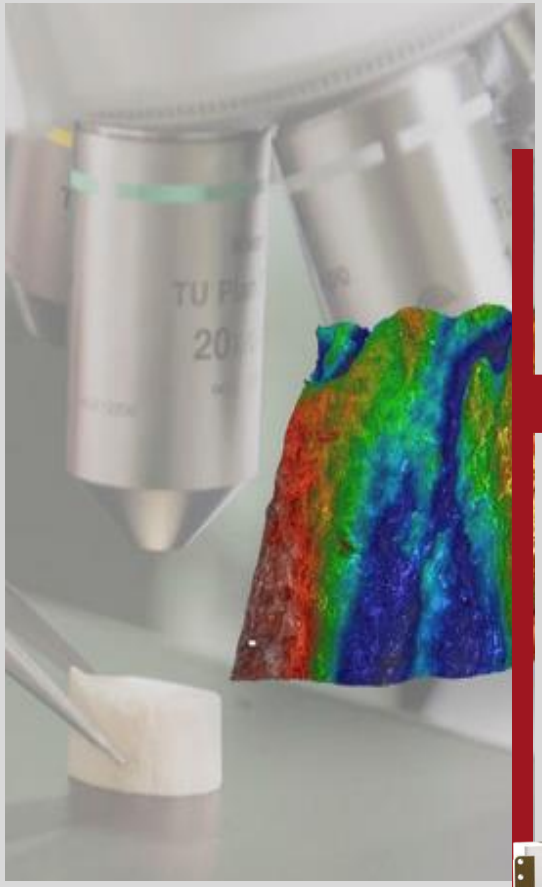
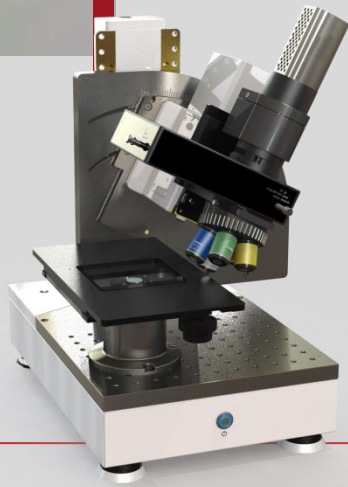


OPTICAL PROFILERS

- For R & D and Industry
- Best price/performance
- Automated
- Large sample
- Dynamic Measurements
- Stress
- **Automotive, lense, energy, ballistics, dental implants, medtech, laser, microelectronics, optics, tooling…**



Filmetrics

Filmetrics was founded in 1995 with the mission of making thin-film measurements simple and affordable. The Filmetrics approach, borne from the microelectronics and software revolution, results in film-thickness measurements that take less than a second.

FILMETRICS
A KLA Company

THIN FILM MEASUREMENTS

- Inline monitoring
- Single-spot measurements
- Microscopic-spot measurements
- **Dielectrics, Glass & Plastic Thickness, Hardcoat Thickness, ITO & Other TCOs, Photoresist, Silicon Wafers & Membranes, Solar Applications, Semiconductor Teaching Labs**

PREVAC

Prevac, one of the world's leading manufacturers of research equipment for analysis **of high and ultra high vacuum applications**. It specialises in delivering custom **deposition and analysis**

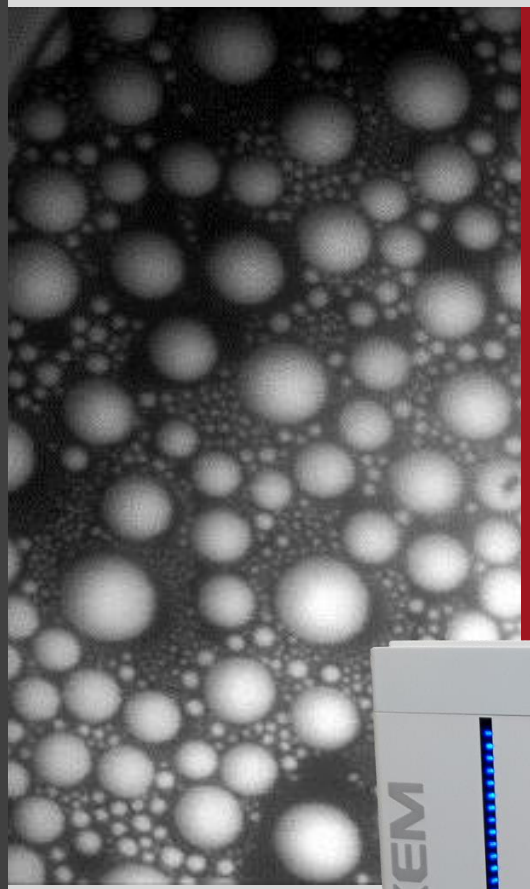
ULTRA HIGH VACUUM SYSTEMS

Deposition and analysis

- XPS, UPS, ARPES, FTIR, AFM, MBE, PLD, CVS, Sputter deposition, thermal evaporation
- Manipulators
- Goniometer
- Chamber
- Sample holders
- Instruments
- Accessories…

COXEM

COXEM is leading Manufacturer of Scanning Electron Microscope(SEM). SEM is the most widely used platform technology in Nano-Metrology of Nano-scale.



SEM MICROSCOPES

- High resolution surface analysis
- Intuitive User Interface
- All-in-one Model of SEM-EDS
- Sample preparation system
- Scanning Electron Particle
- **Analyzer Automotive, smartphone, semiconductor, chemical, construction, energy, metal material, bioengineering, display, education…**

II. Polisseur Ionique

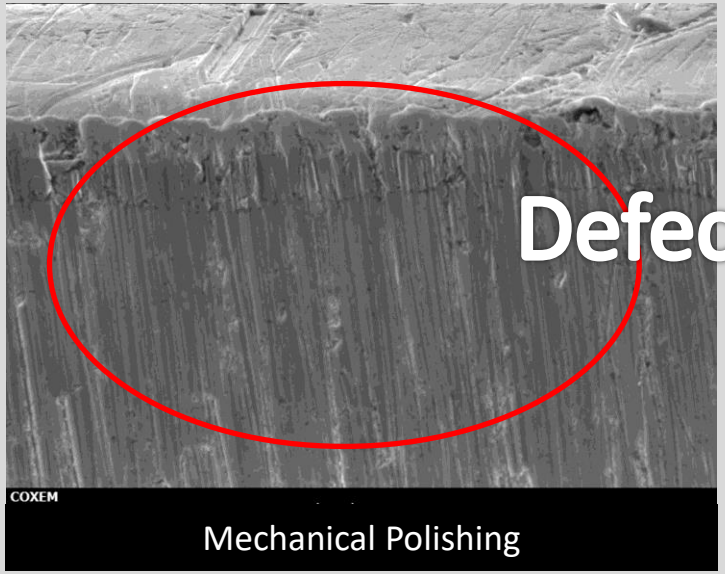
Why Use a Cross Section Polisher?

- Get a **clean surface** with a very **low roughness** in order to image small structures avoiding deformation and distortion of the specimen.

  - Preserves the internal structure of the specimen
  - **Avoids chemical change** (no chemical etching process).
  - Minimal effort is needed to achieve a clean cross section surface.

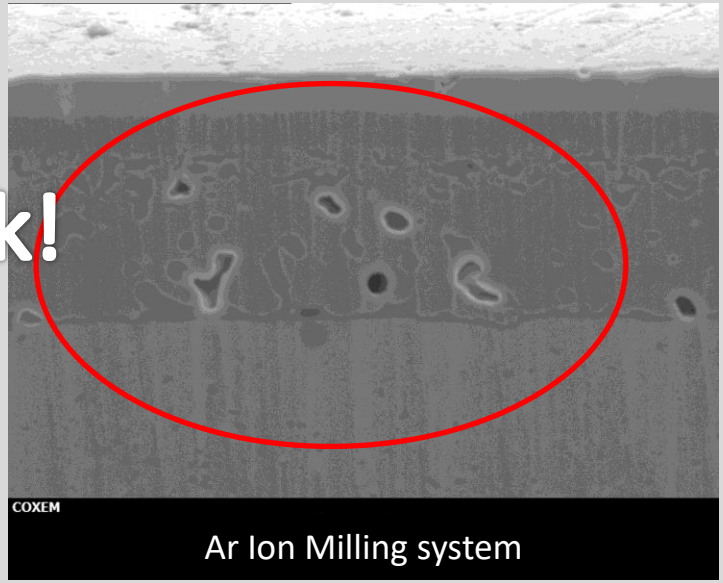
- Conventional mechanical polishing can cause surface damage that will inhibit clear and precise imaging.

Why Use a Cross Section Polisher?



Mechanical Polishing

Defect check!



Ar Ion Milling system

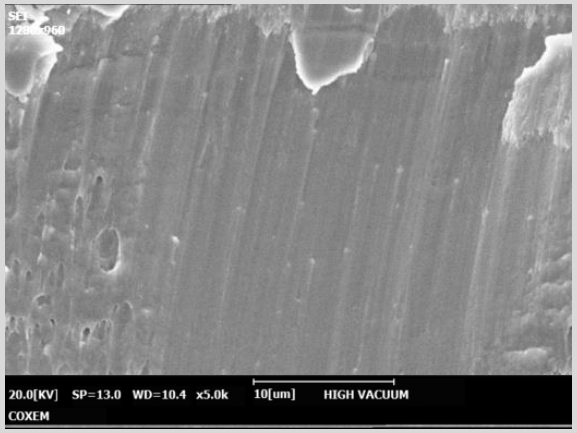
Mechanical polishing vs CP polishing

An ION mill is capable of polishing to a **molecular level** without surface distortion or visible scratches.

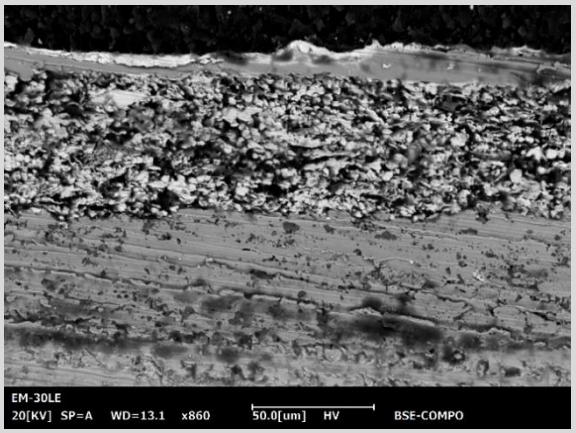
Wide range of samples, from microns to millimeters in width provides the same result as high-end micromachines such as FIB.

- Before CP vs After CP

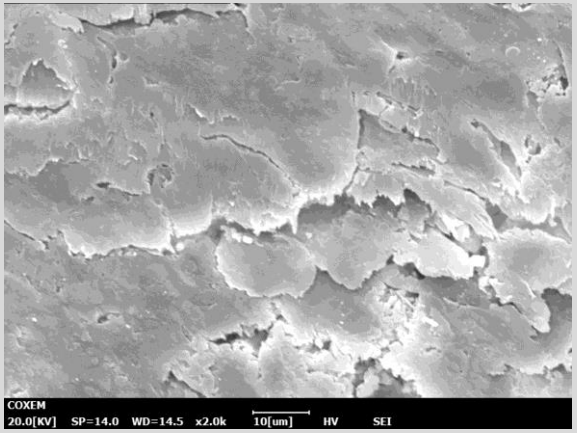
Before Image.



Connector

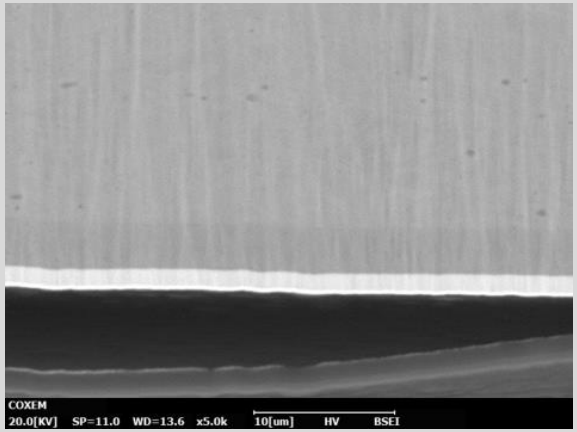


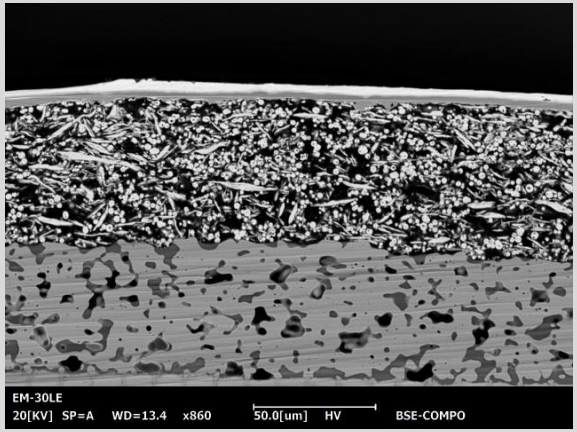
MLCC

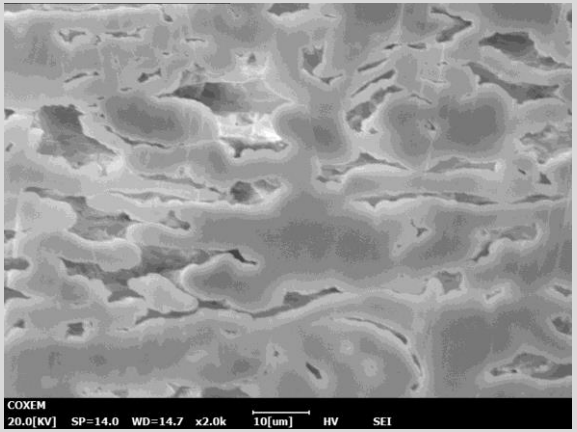


Paper

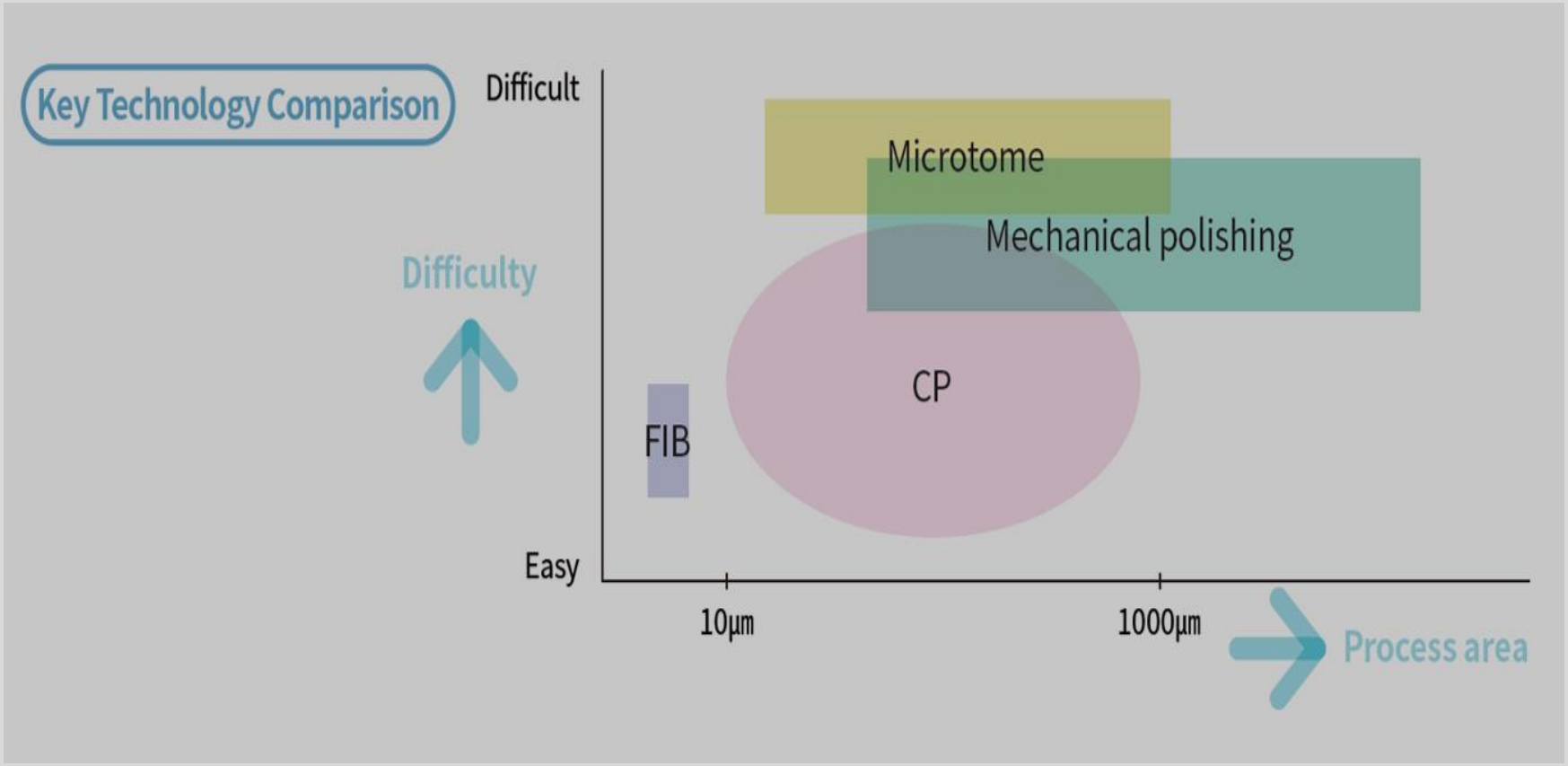
after Image.



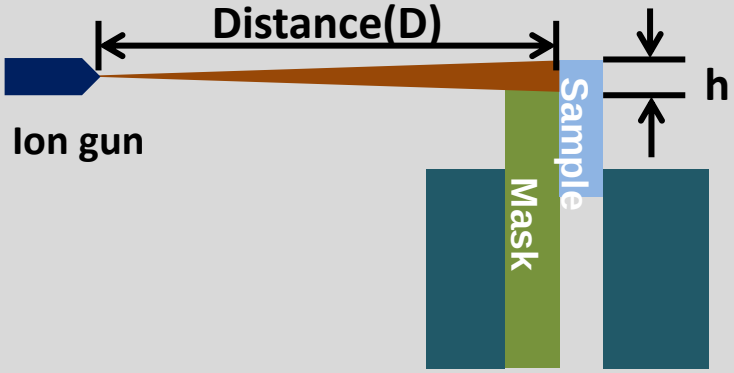


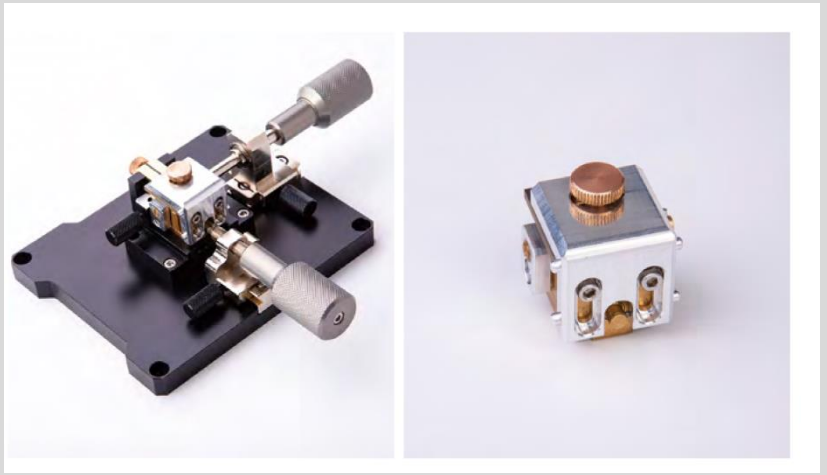


When Use a Cross Section Polisher?



Principle





CP-8000 (Cross-section Polisher)

Coxem's CP 8000 is a cross-section polisher that prepares a sample by etching its cross section using argon plasma

COXEM

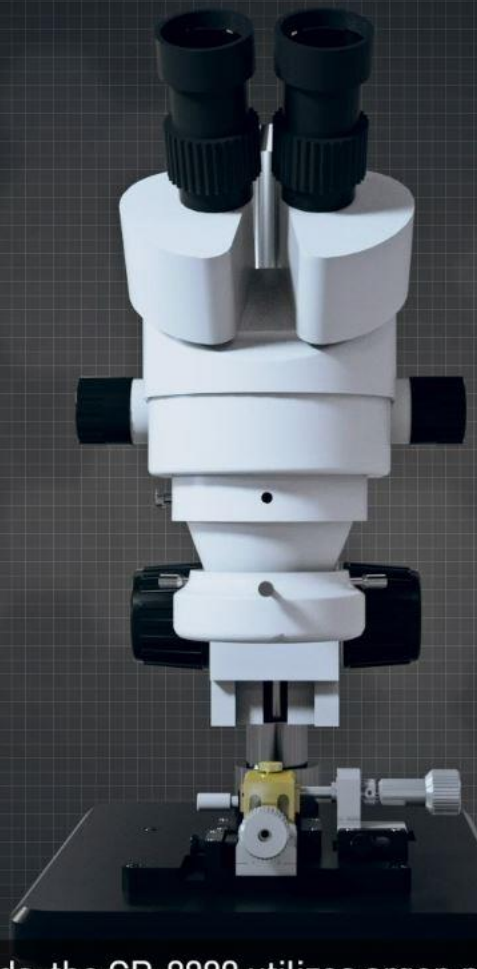

COXEM
CP-8000
OPEN
CP-8000
Unlike the existing polishing methods, the CP-8000 utilizes argon plasma, not sandpaper or human hands,

Sample Alignment

Unlike the existing polishing methods, the CP-8000 utilizes argon plasma, not sandpaper or human hands,

COXEM

Sample Alignment



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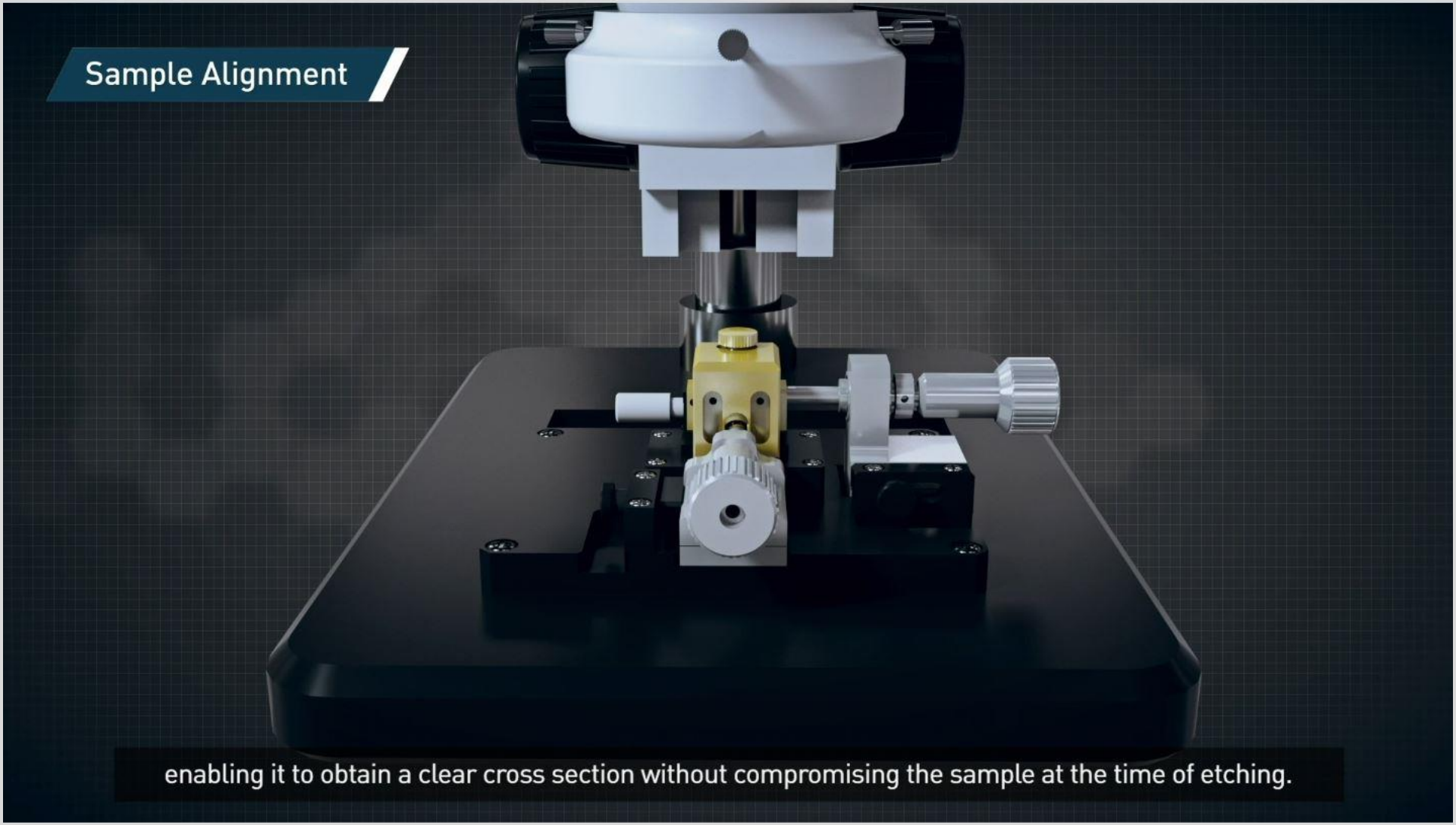
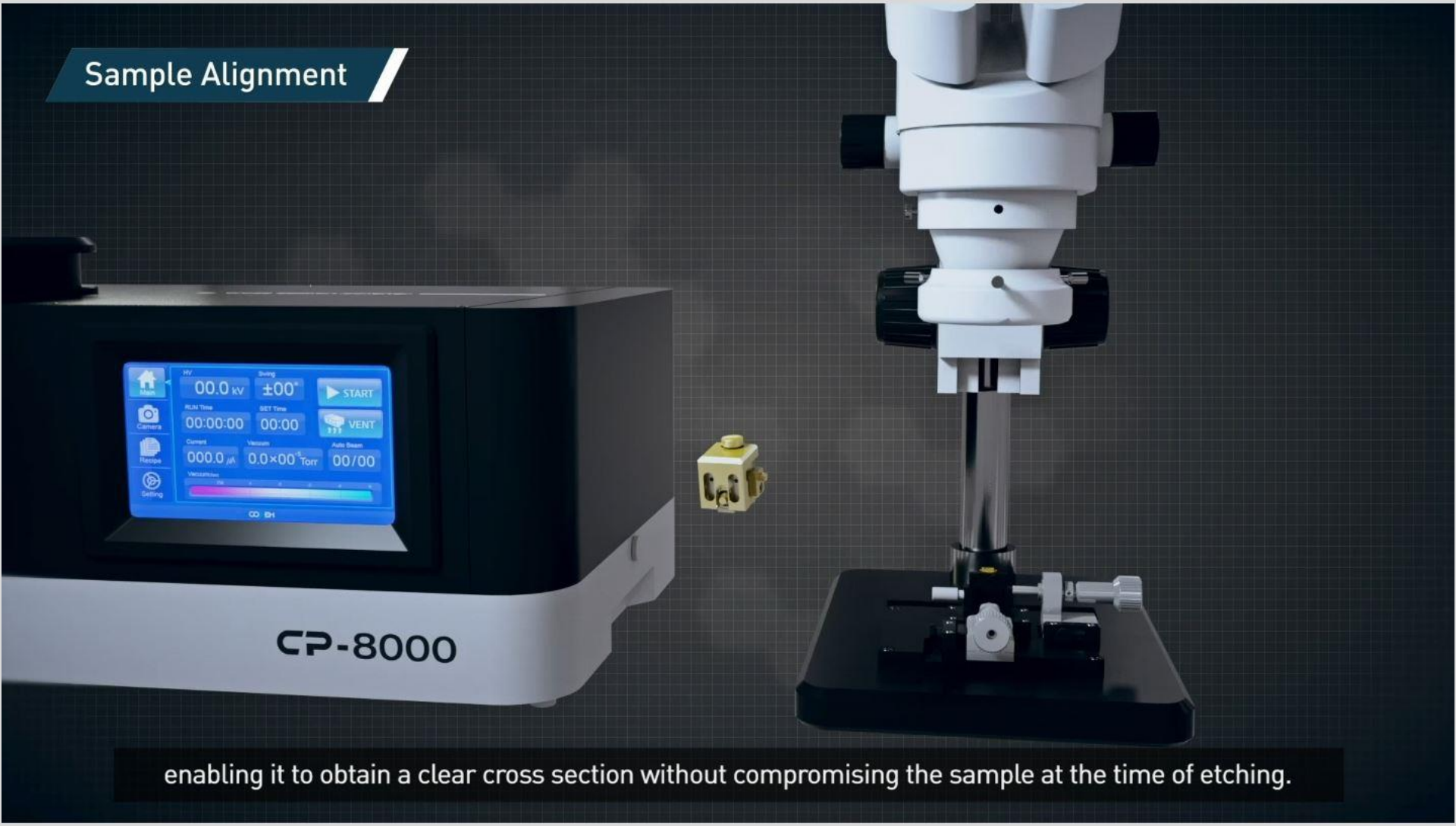

Sample Alignment
enabling it to obtain a clear cross section without compromising the sample at the time of etching.


Sample Alignment
CP-8000
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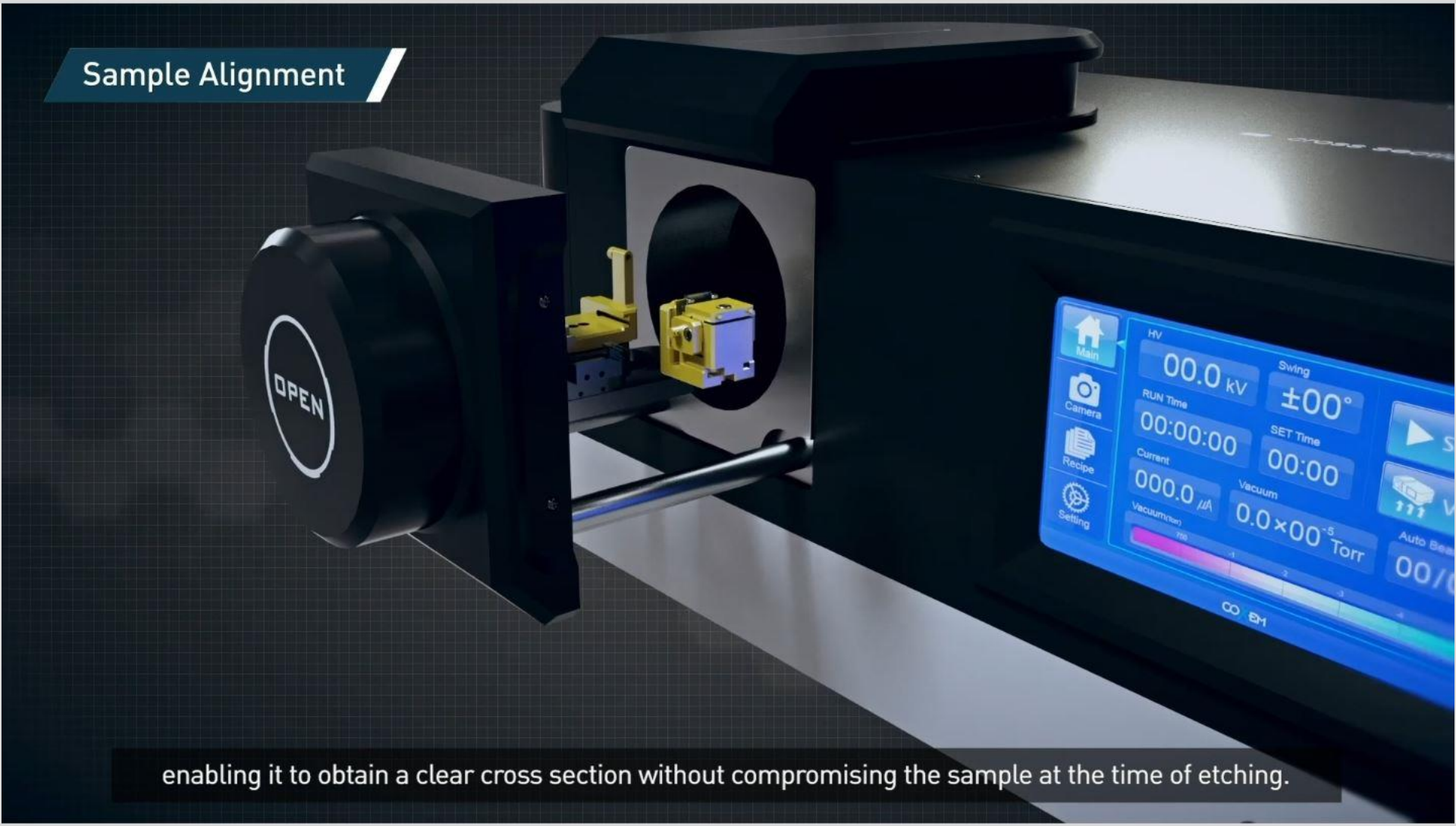
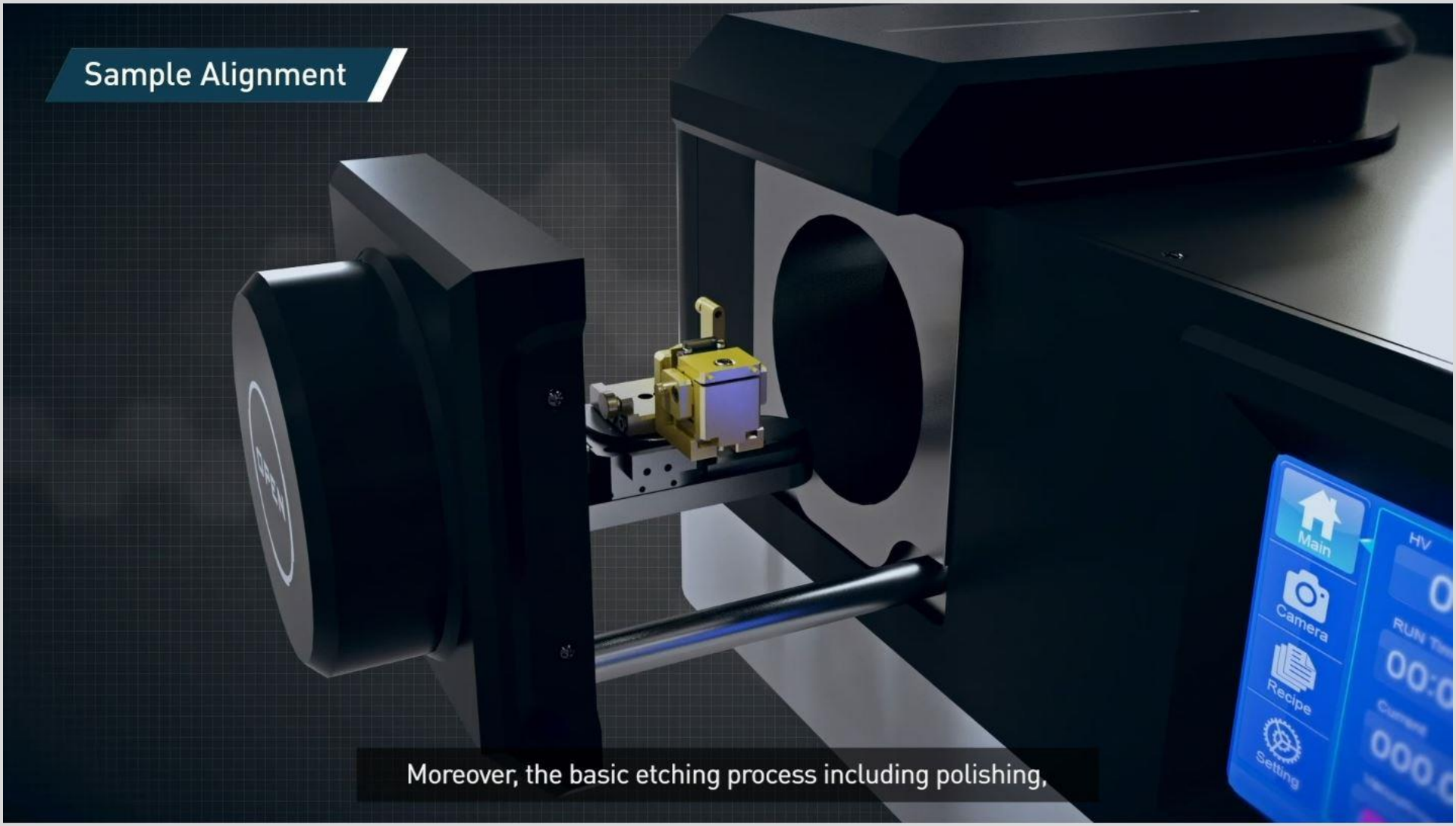
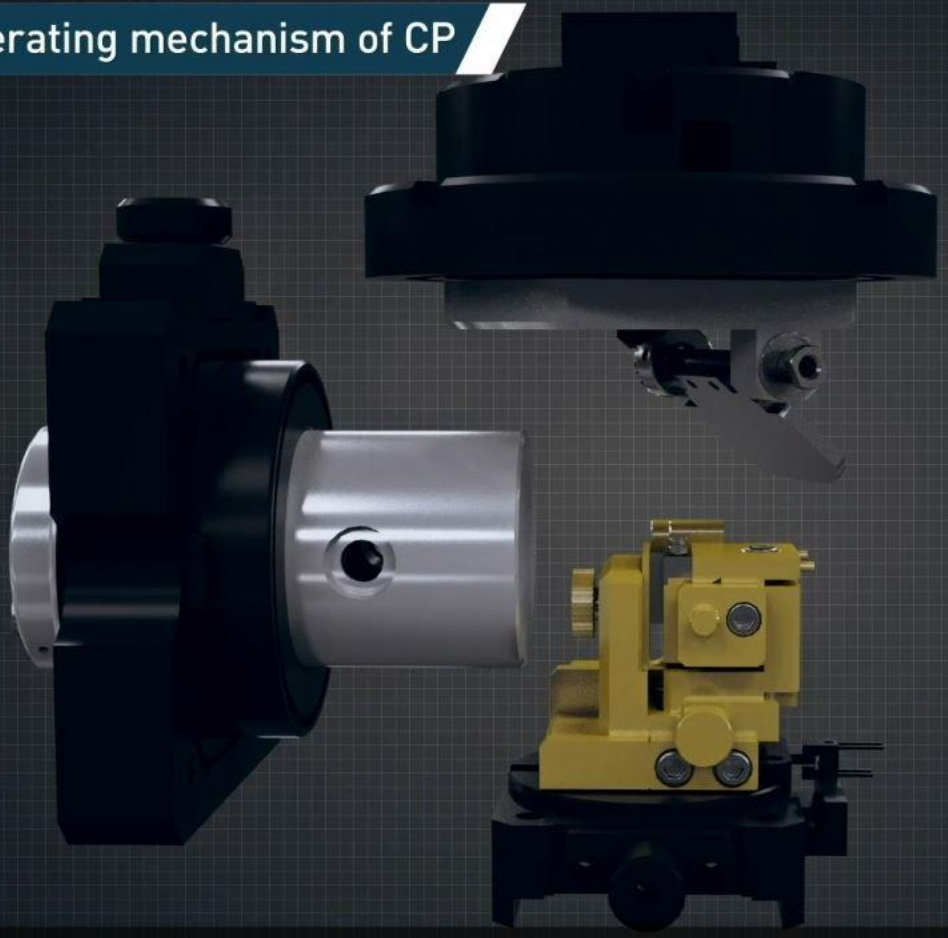

Sample Alignment
OPEN
Main
Camera
Recipe
Setting
HV
00.0 kV
Swing
±00°
RUN Time
00:00:00
SET Time
00:00
Current
000.0 μA
Vacuum
0.0×00 -5 Torr
enabling it to obtain a clear cross section without compromising the sample at the time of etching.


Sample Alignment
Main
Camera
Recipe
Setting
HV
Moreover, the basic etching process including polishing,

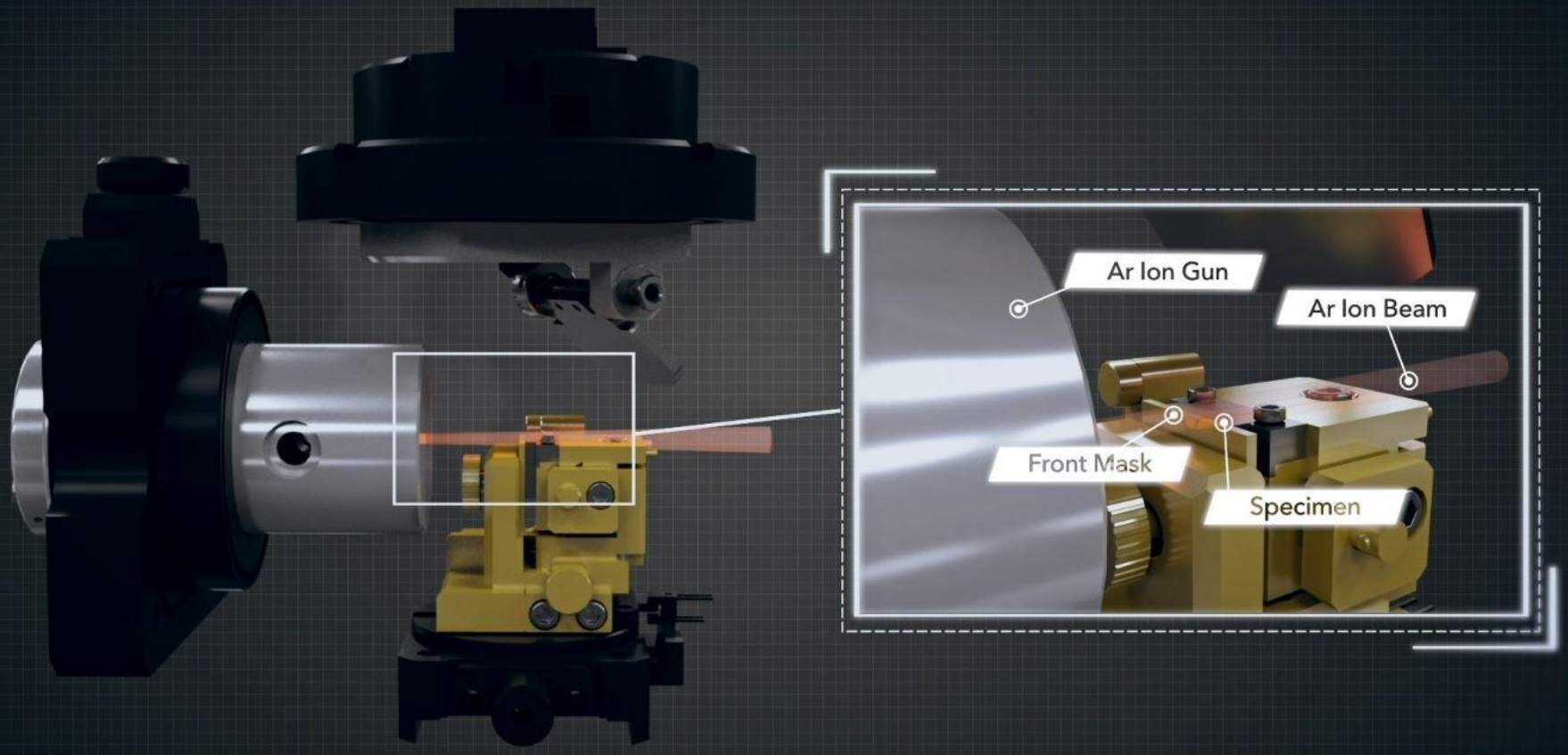
COXEM

Internal operating mechanism of CP



etching and cleaning can be simplified to one-time polishing, which can still provide a clear cross section area.

Internal operating mechanism of CP



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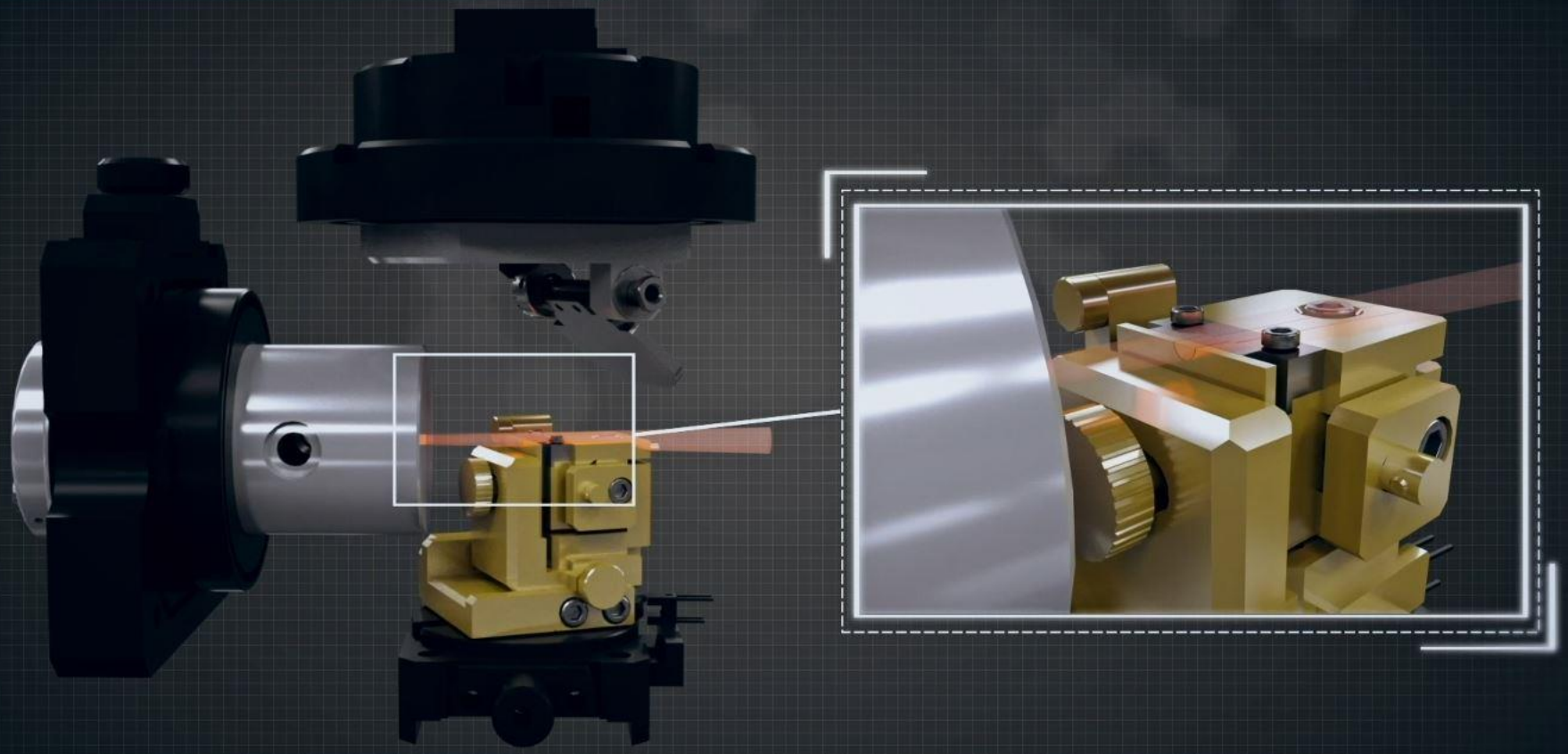
COXEM

Internal operating mechanism of CP

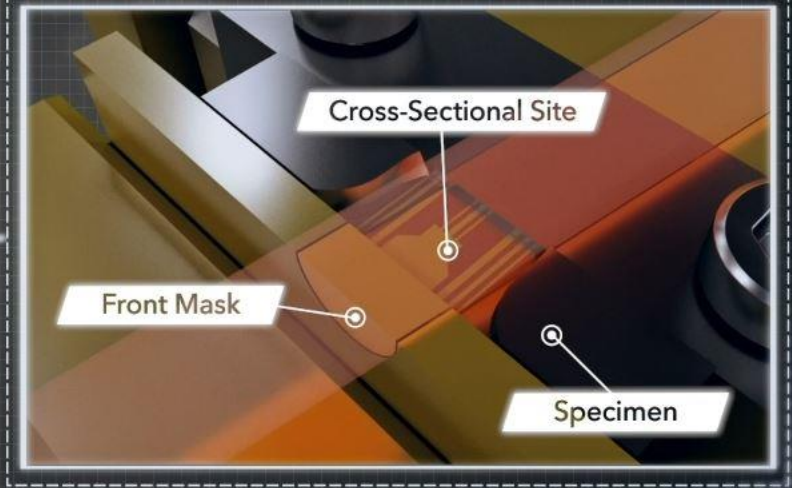


Our CP-8000 allows clear observation of nano-and micro-scale areas inside the sample.

Cross section polishing

BEFORE

AFTER

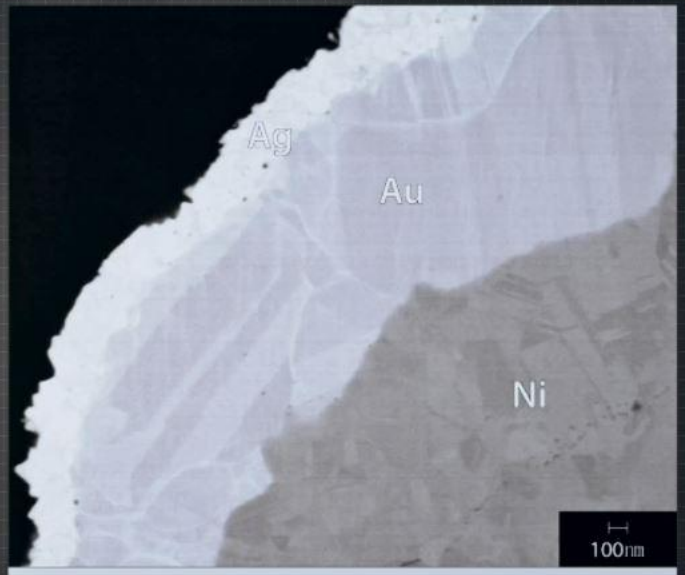


At the same time, large area polishing can also be done with the CP-8000, which, through its swinging stage, makes possible the observation of a few hundred micro-thick areas within one hour.

COXEM

Nano Particle

BSE Image at ×5K
Specimen: Powder



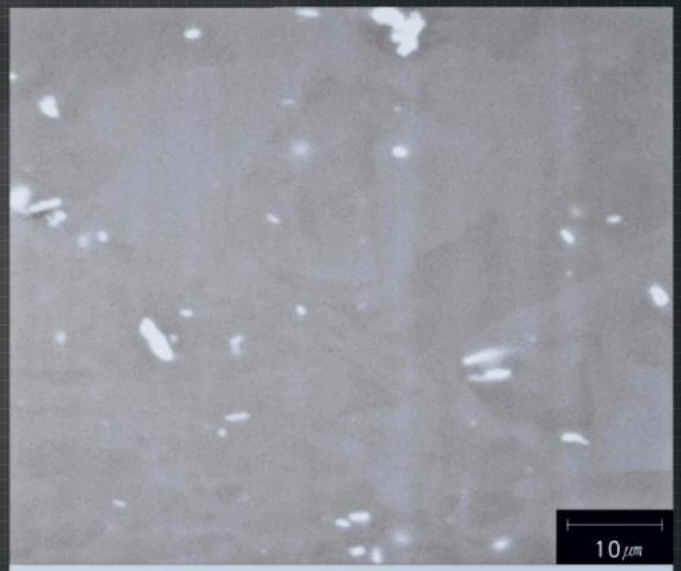
BSE Image at ×30K
Specimen: Powder

makes possible the observation of a few hundred micro-thick areas within one hour.

COXEM

Alloys

BSE Image at ×1.5K
Specimen: Cu Alloy

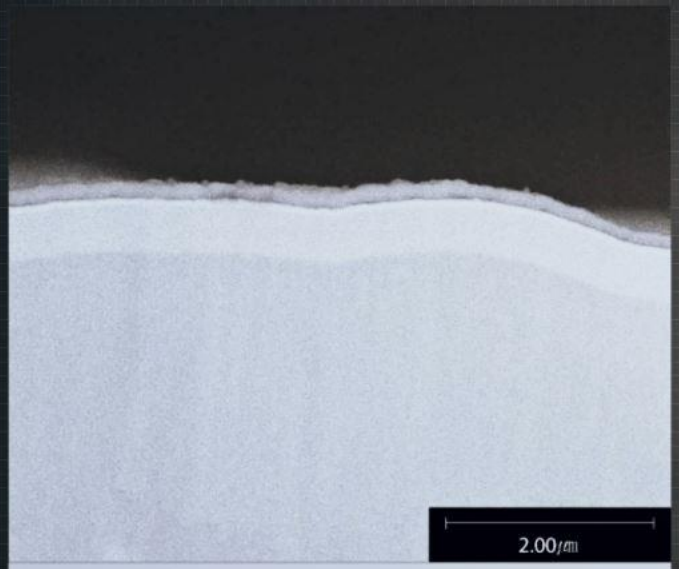


BSE Image at ×5K
Specimen: Al Alloy

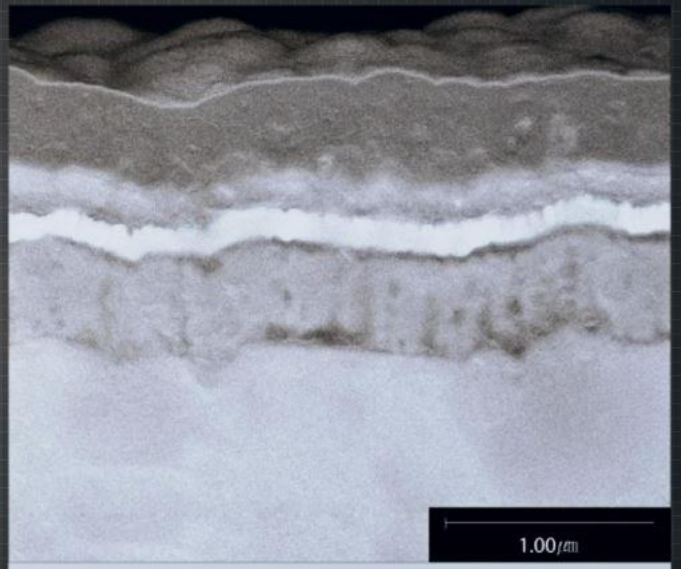
As for the application, the CP-8000 can be used to view inside a nano-sized particle to observe its internal structure

COXEM

Multi-layer Structure



BSE Image at ×20K
Specimen: Connetor



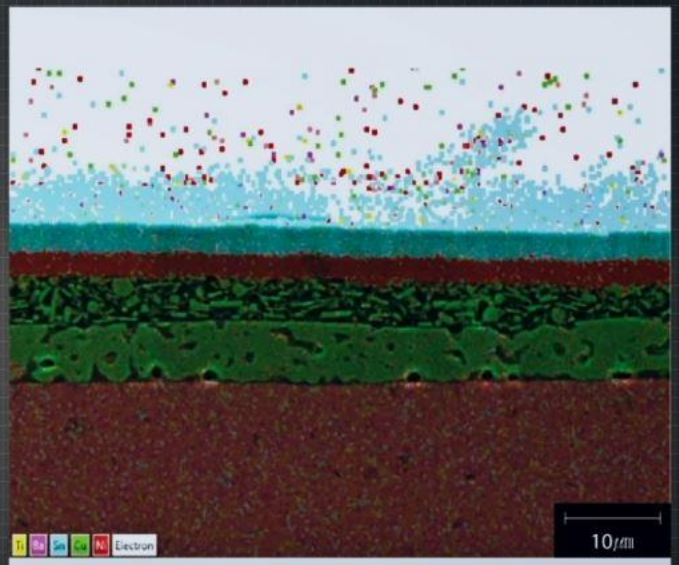
BSE Image at ×40K
Specimen: Layered structures(CIGS solar cell)

As for the application, the CP-8000 can be used to view inside a nano-sized particle to observe its internal structure

COXEM

Multi-layer Structure

BSE Image at ×2K
Specimen: Layered structures(MLCC)

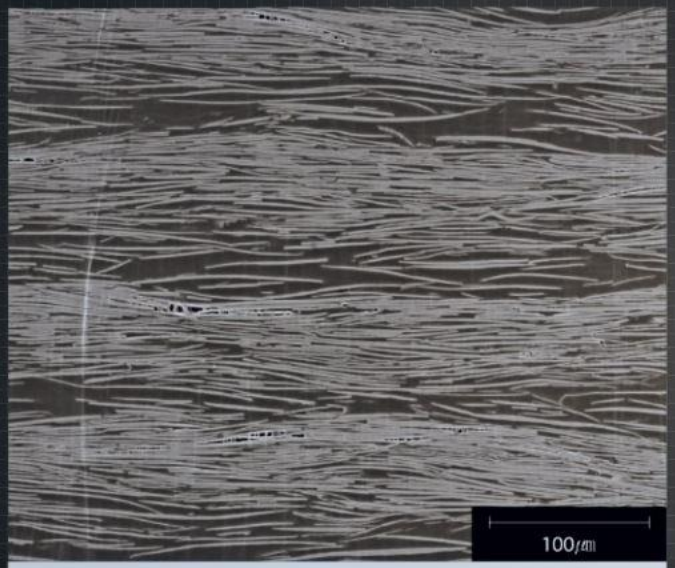


EDS Image at ×2K
Specimen: Layered structures(MLCC)

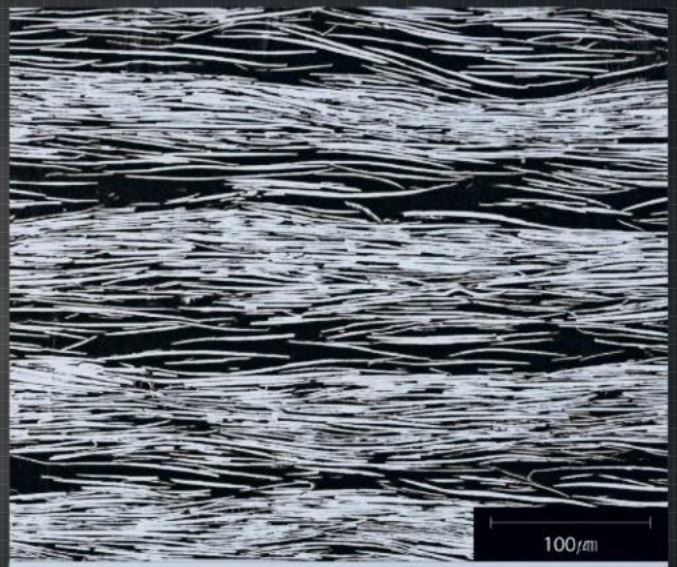
As for the application, the CP-8000 can be used to view inside a nano-sized particle to observe its internal structure

COXEM

Micro Fiber



SE Image at ×2K
Specimen: Fibers

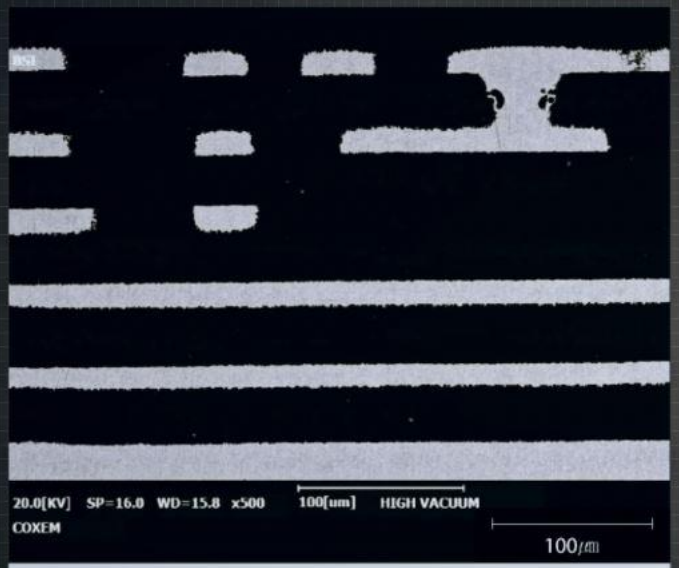


BSE Image at ×2K
Specimen: Fibers

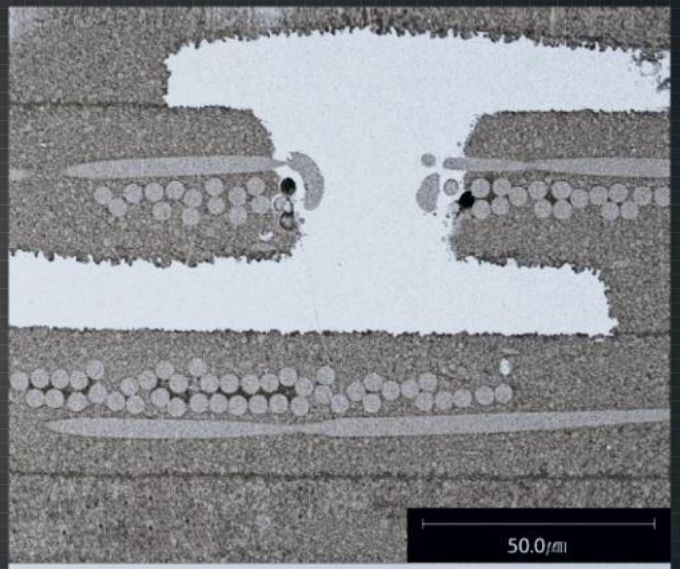
as well as to view inside a nanowire, nano fiber or a stacked semiconductor device.

COXEM

Semiconductor



BSE Image at ×500
Specimen: PCB Board

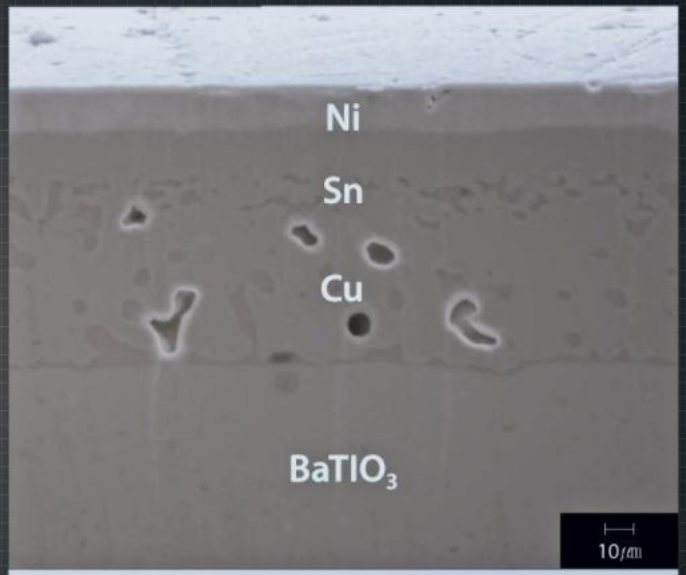


BSE Image at ×2K
Specimen: PCB Board

as well as to view inside a nanowire, nano fiber or a stacked semiconductor device.

Comparison of Mechanical Milling and Ion Beam Milling Images

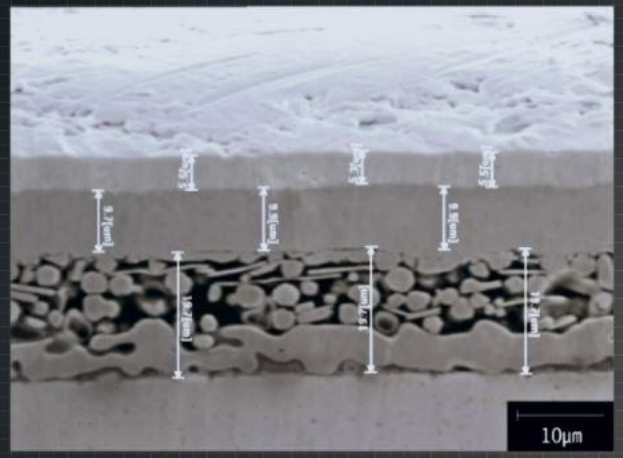
Mechanical Polishing

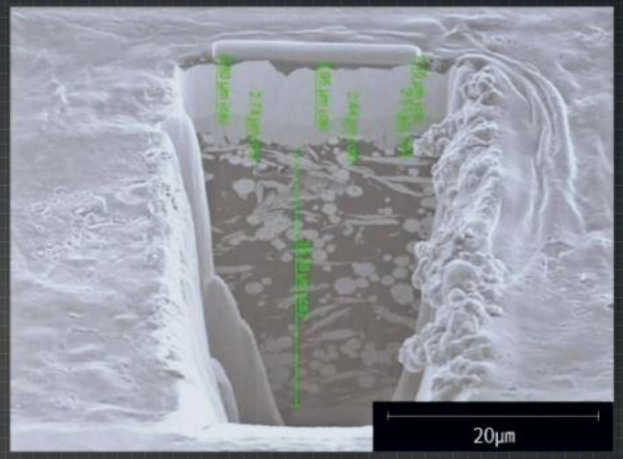


Ion Beam Polishing

In addition, the CP-8000 can provide support for the preparation of metal and ceramic materials

Comparison of CP and FIB Milling Images





Parameters	CP-8000	FIB
Beam Current	36µA (Ar Ion Beam)	26.6µA (Ga Ion)

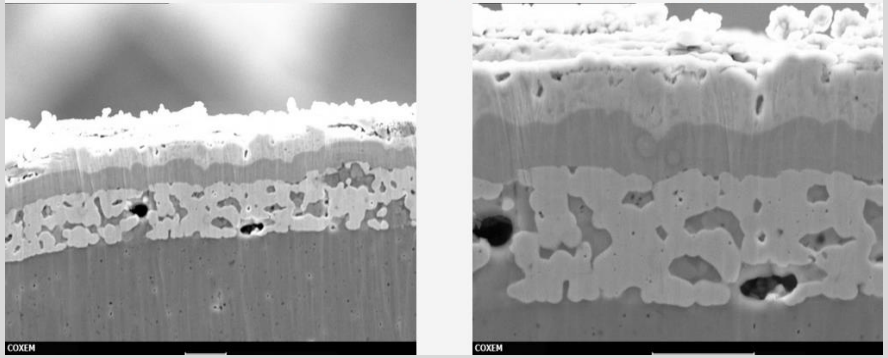
In addition, the CP-8000 can provide support for the preparation of metal and ceramic materials by polishing them for a subsequent analysis of their internal structure images and EBSD data.


CP-8000
by polishing them for a subsequent analysis of their internal structure images and EBSD data,

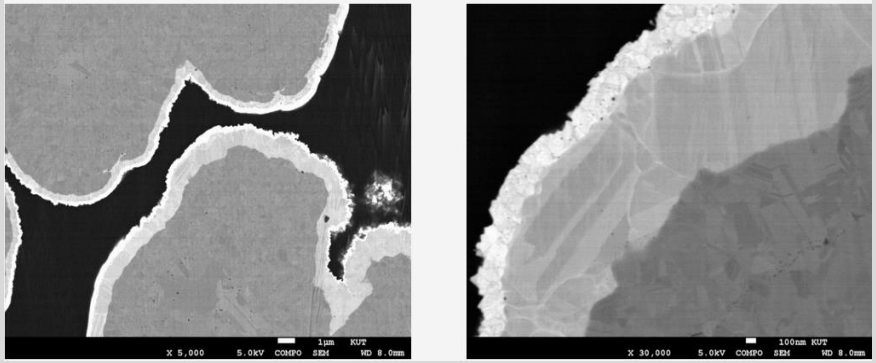
so as to allow the observation of grains from these types of samples.

Examples

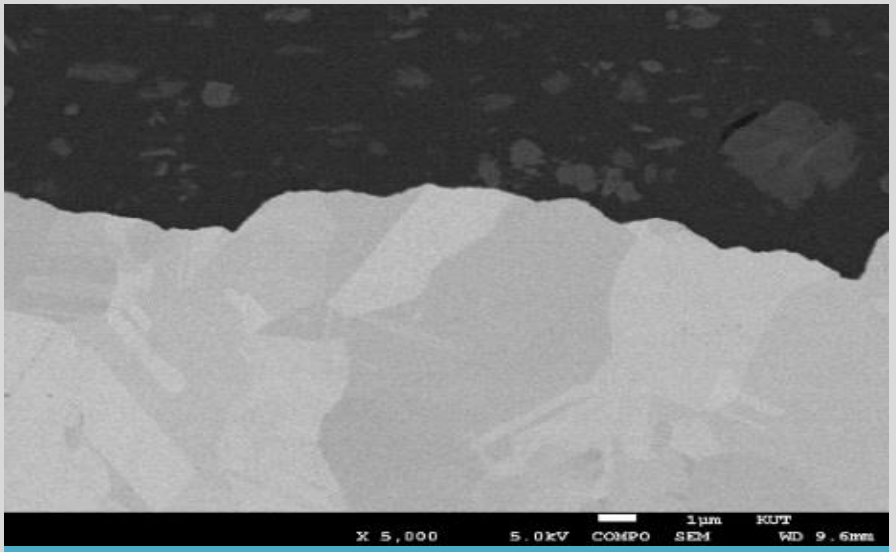
Multi-Layer Material at 2,000X and 5,000X (SE):



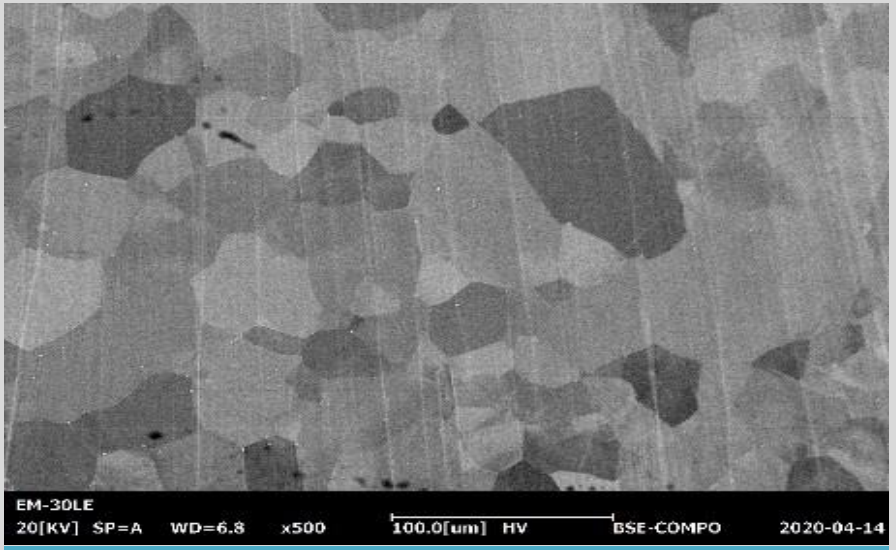
Nano-Scale Coated Powder at 5,000X and 30,000X (BSE):



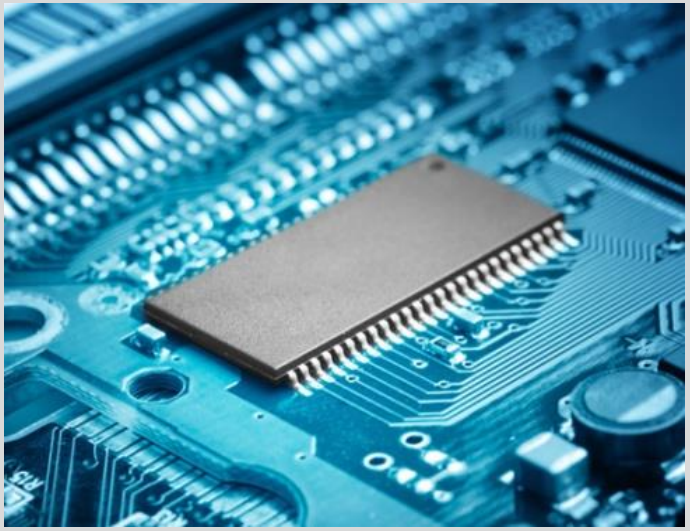
Alloys Materials

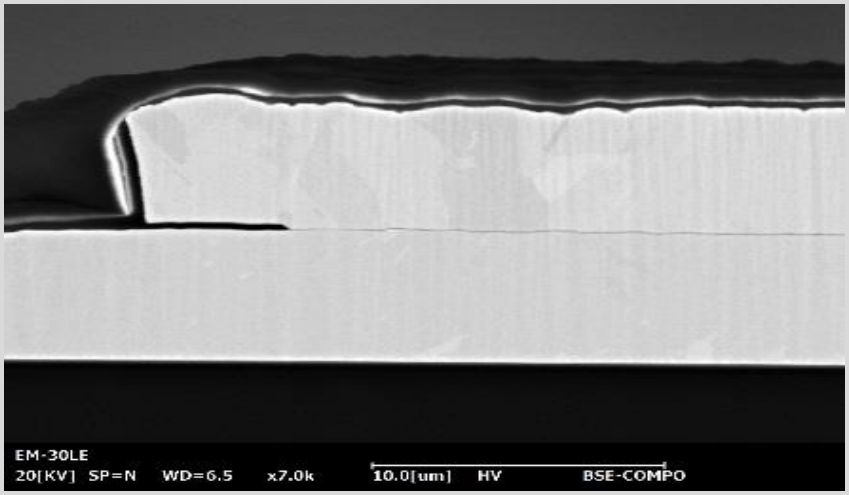


BSE Image ×5K / Specimen: Ni alloy Metal



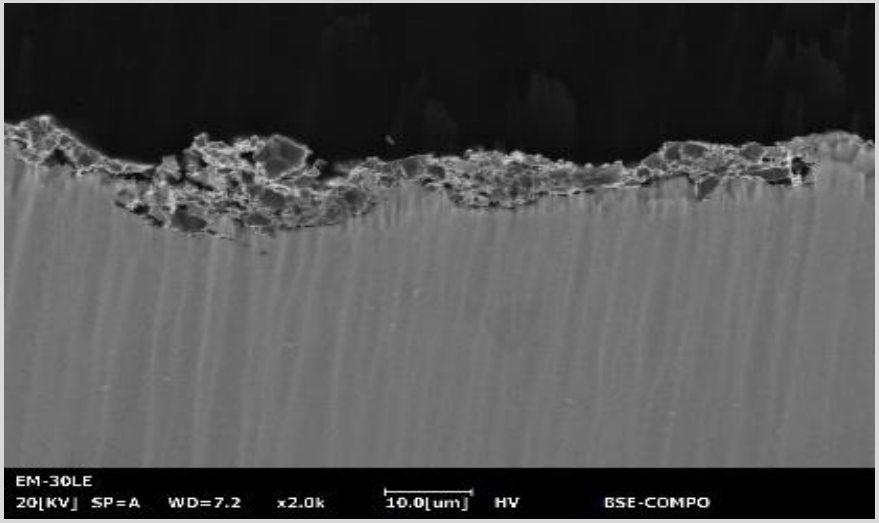
BSE Image ×500 / Specimen: Al alloy Metal



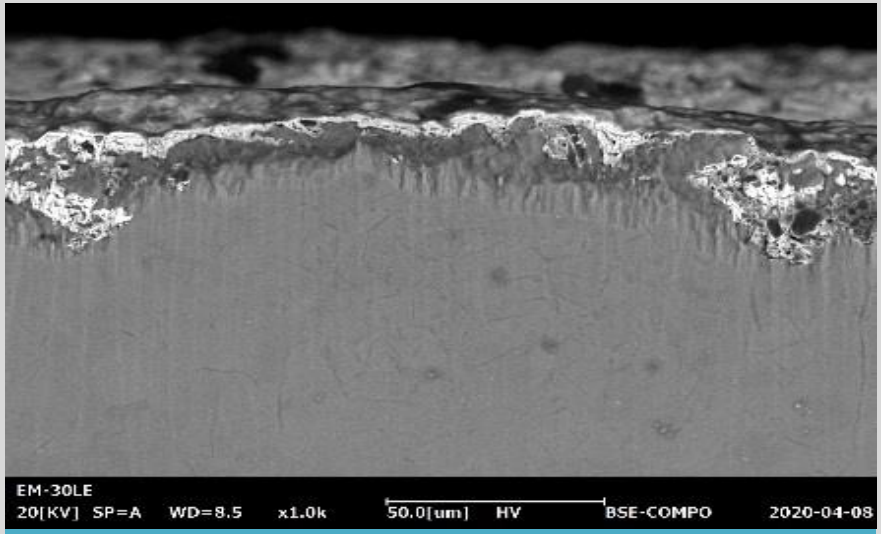


BSE Image ×7K / Specimen: Wafer

BSE Image ×500 / Specimen: Wafer

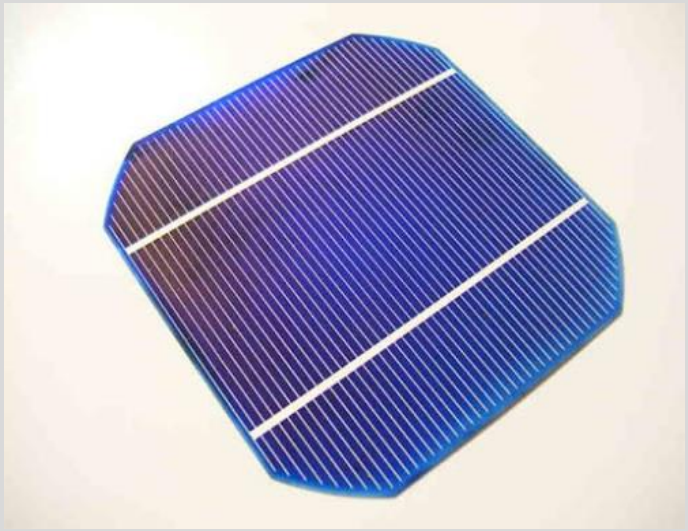


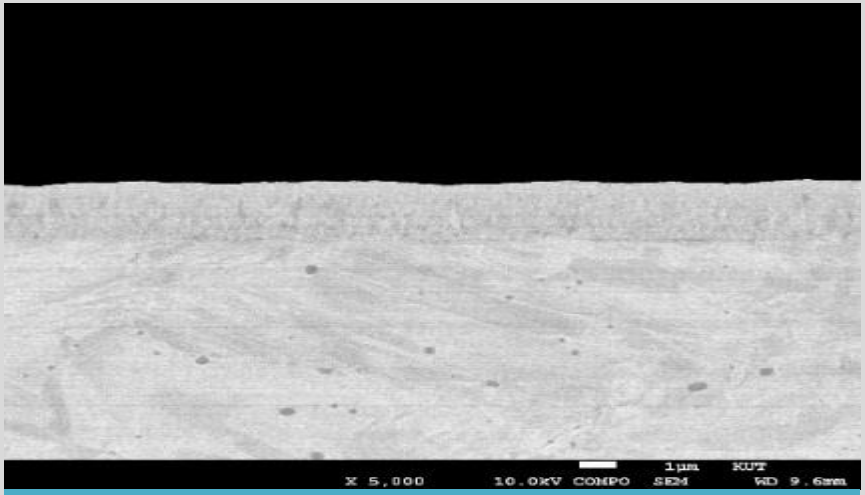
BSE Image ×2K / Specimen: Ceramic



BSE Image ×1K / Specimen: Ceramic

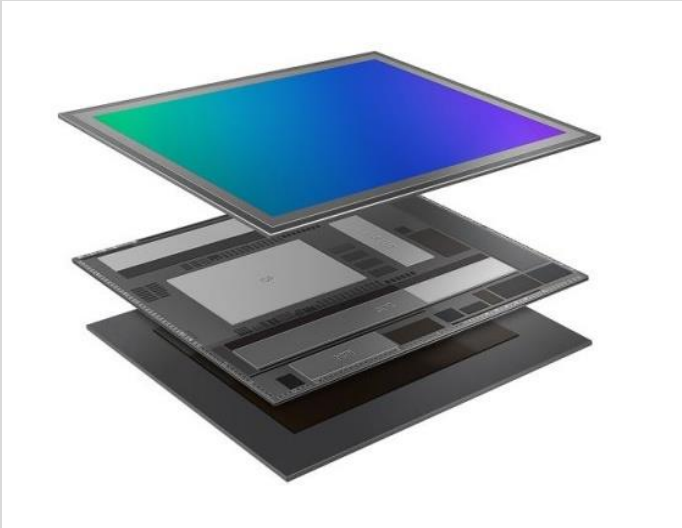
Solar Cell

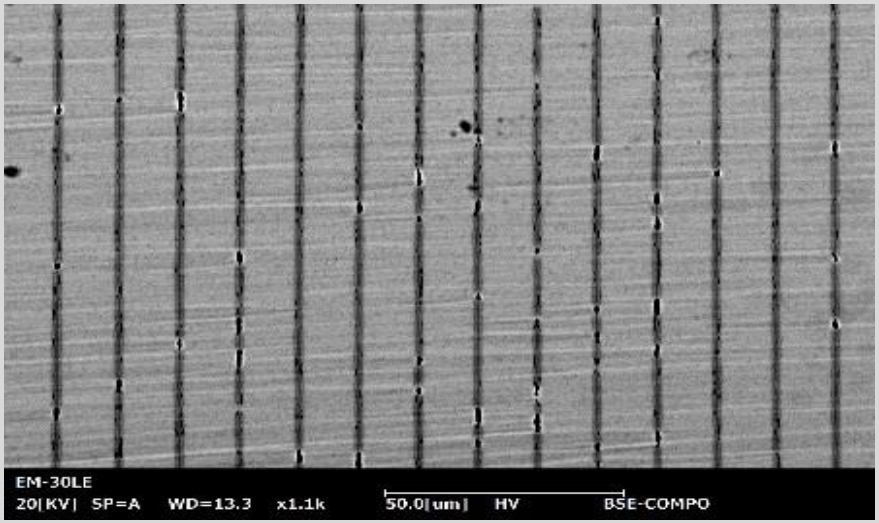




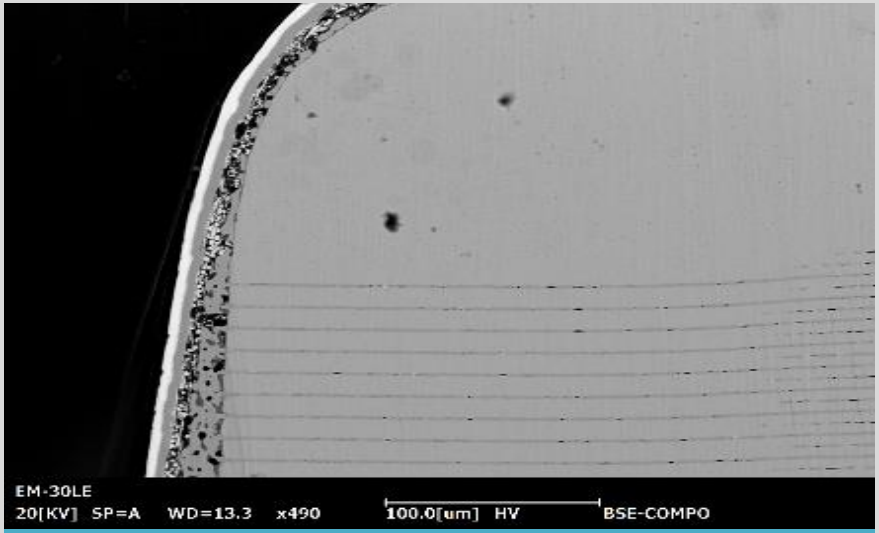
BSE Image ×5K / Specimen: Solar cell electrode

BSE Image ×5K / Specimen: GICC

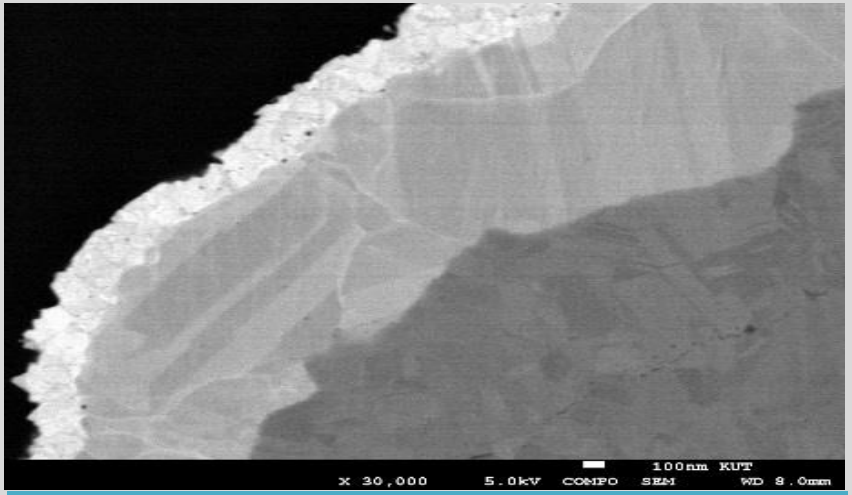




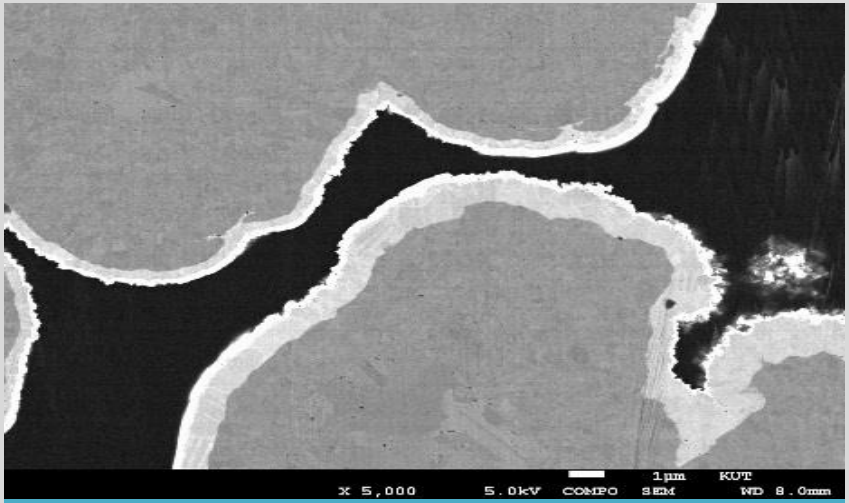
BSE Image ×1.1K / Specimen: MLCC



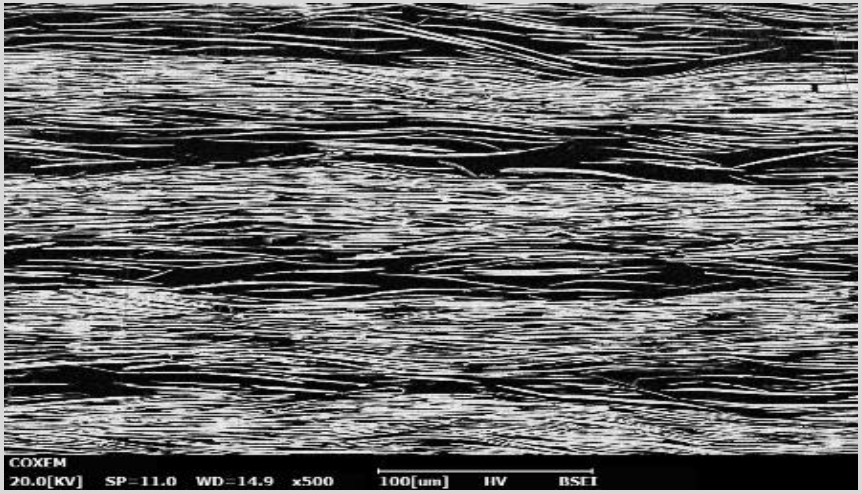
BSE Image ×490 / Specimen: MLCC



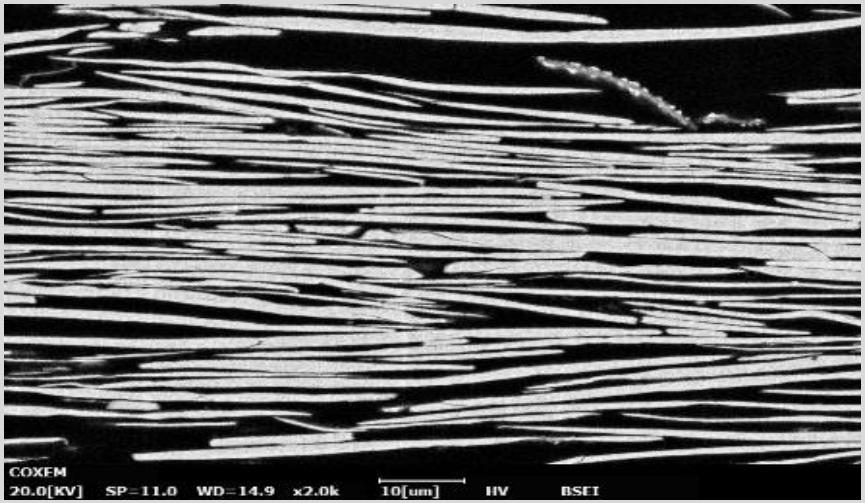
BSE Image ×30K / Specimen: Nano Particle



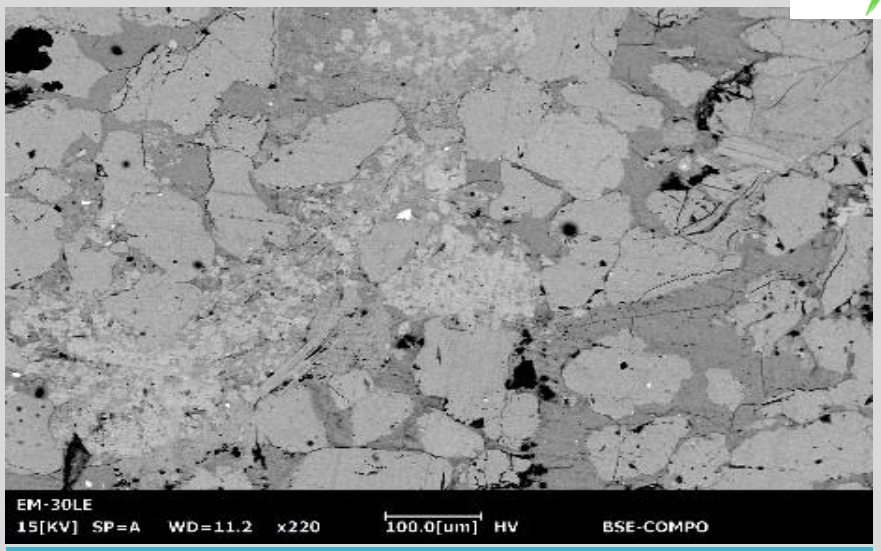
BSE Image ×5K / Specimen: Nano Particle



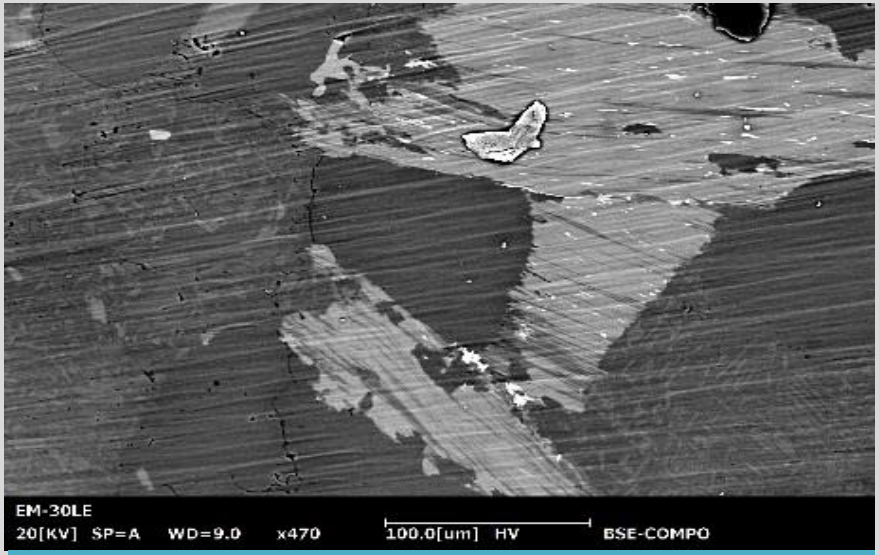
BSE Image ×500 / Specimen: Nano Fiber



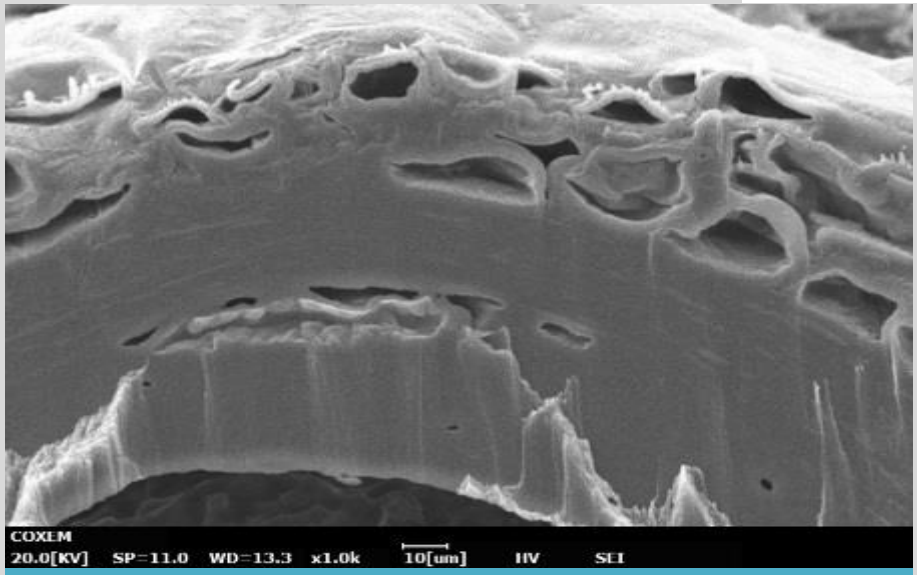
BSE Image ×2K / Specimen: Nano Fiber



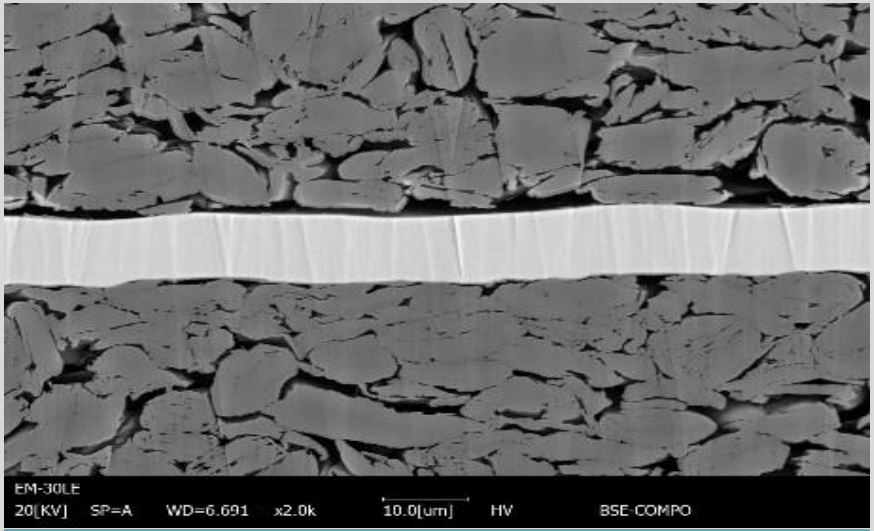
BSE Image ×220 / Specimen: Mineral



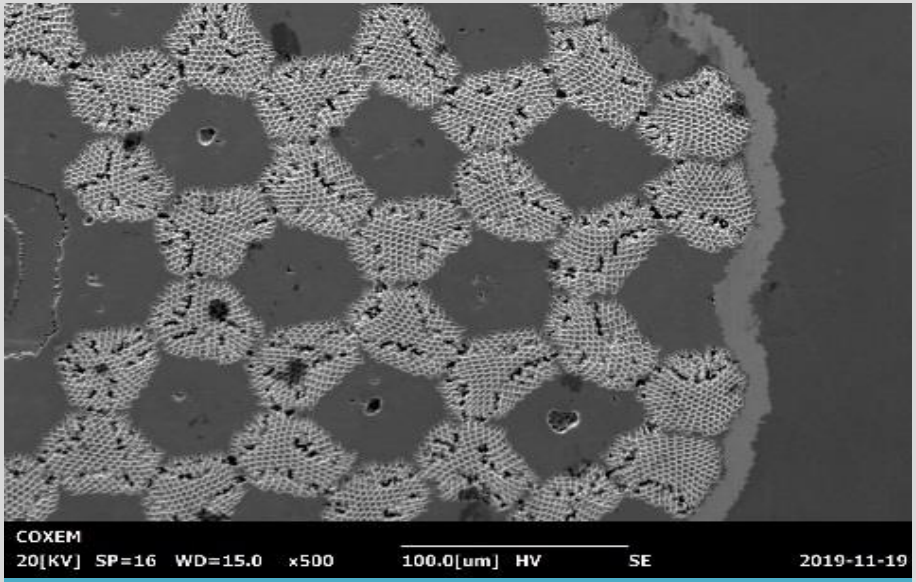
BSE Image ×470 / Specimen: Stone



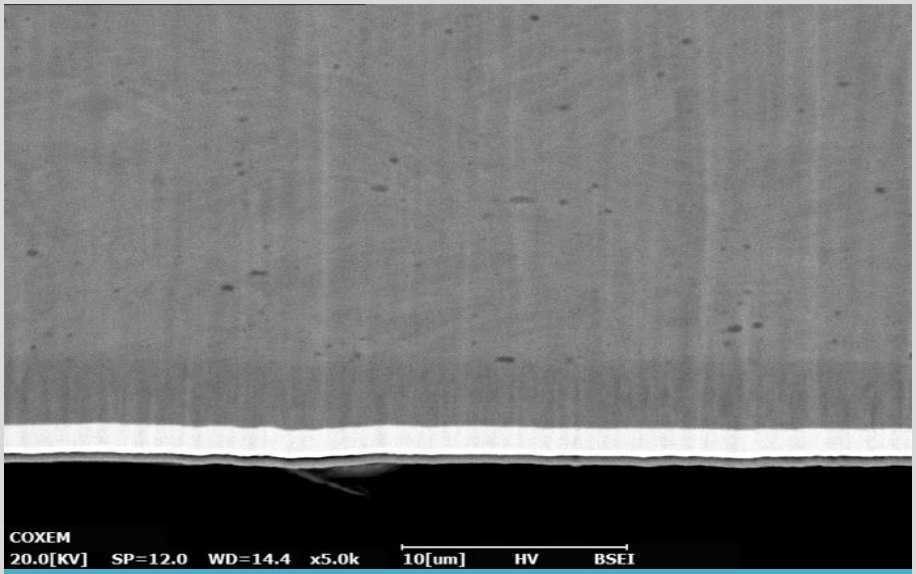
BSE Image ×1K / Specimen: Polymer



BSE Image ×2K / Specimen: Polymer

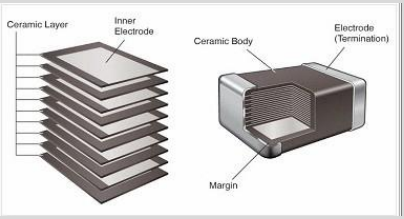


BSE Image ×500 / Specimen: Super conductor

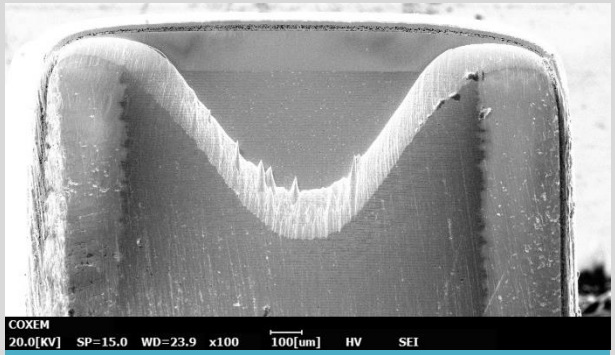


BSE Image ×5K / Specimen: Connector

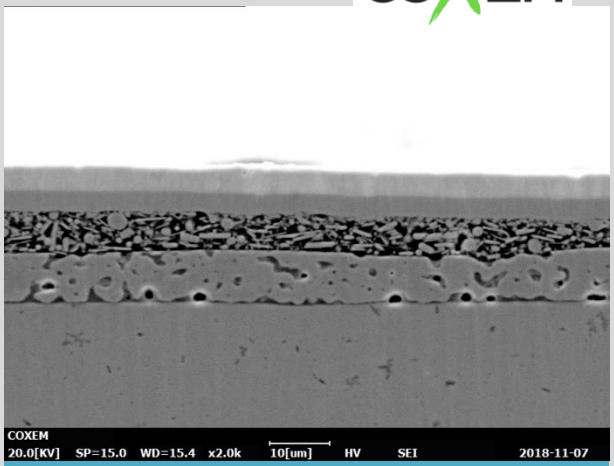
Multi-layer Ceramic Capacitor(MLCC)



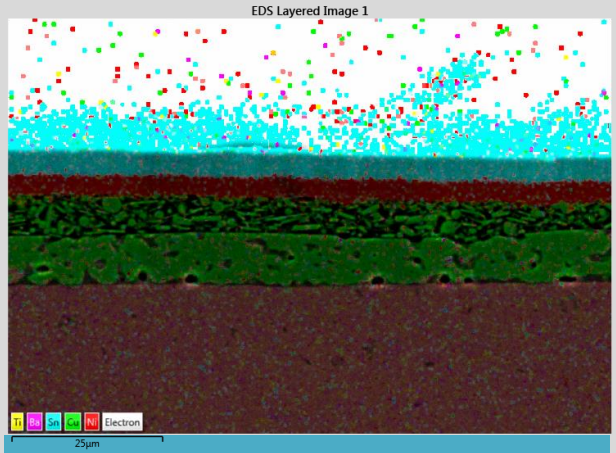
Parameters	Range
Acceleration voltage	5 kV
Gun current	36 µA
Swing	±30°
Milling time	8h



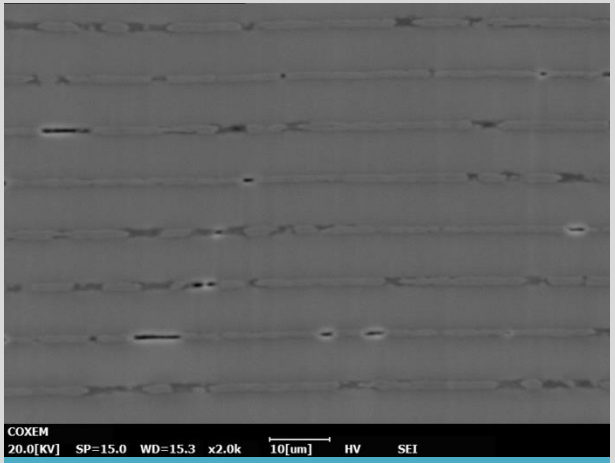
BSE Image ×100
Specimen: MLCC (Capacitor)



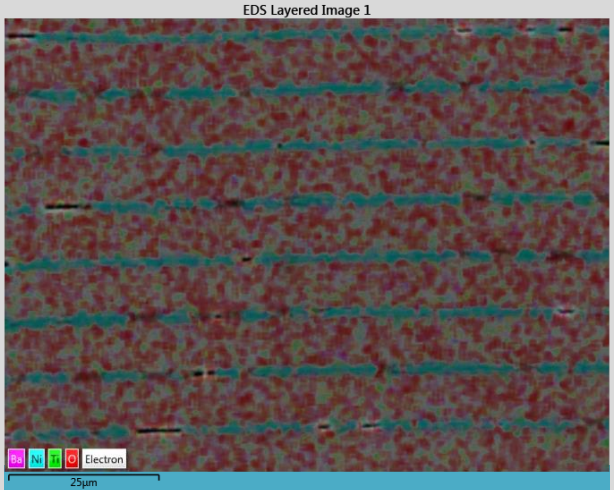
BSE Image ×2K
Specimen: Layered structures (MLCC)



EDS Mapping Image ×2K
Specimen: Sn/Ni/Cu structure

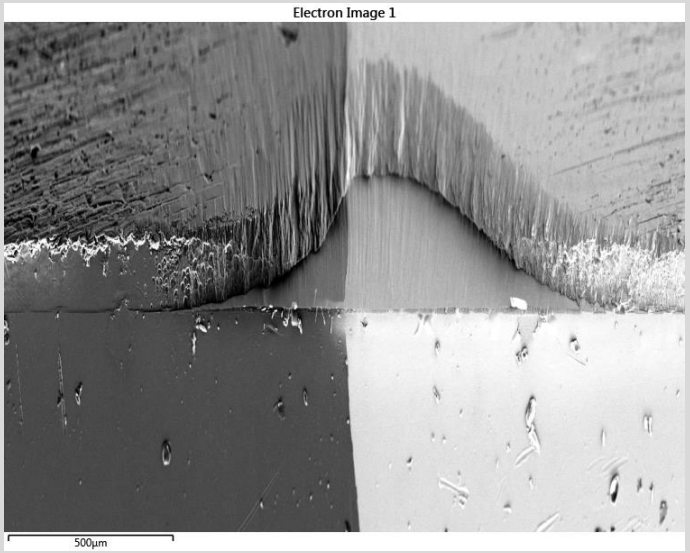


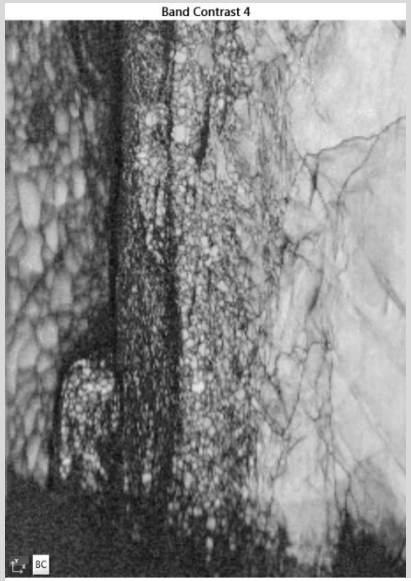
SE Image ×2K
Specimen: Electrode (MLCC)

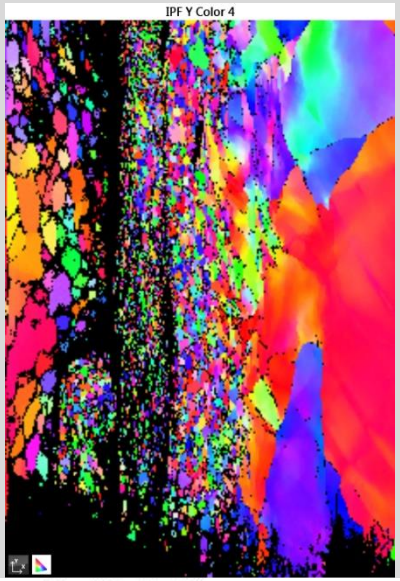


SE Image ×5K
Specimen: Ni/base structures

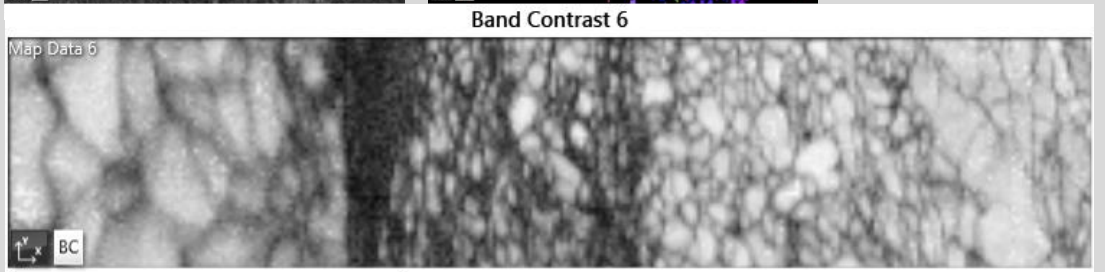
Sample preparation of EBSD

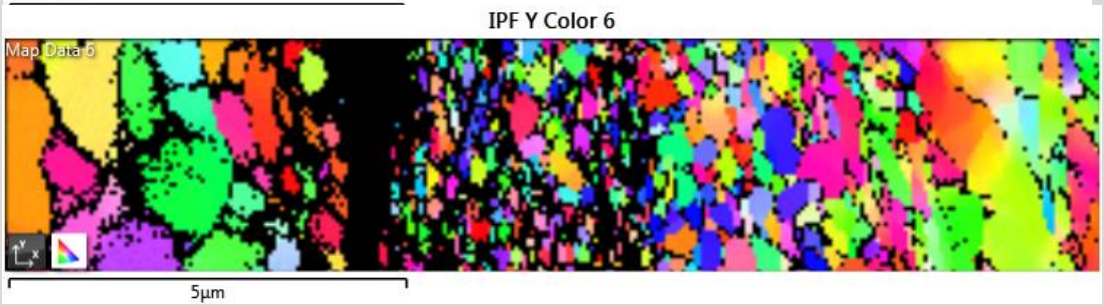




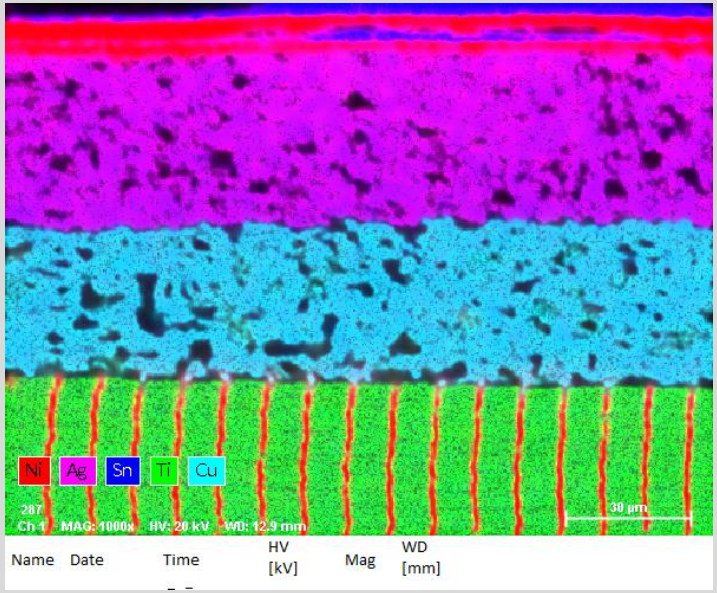


Miling Time : 3h
AccVoltage : 5kV
Swing angle : 35°
Sample : Al-Cu

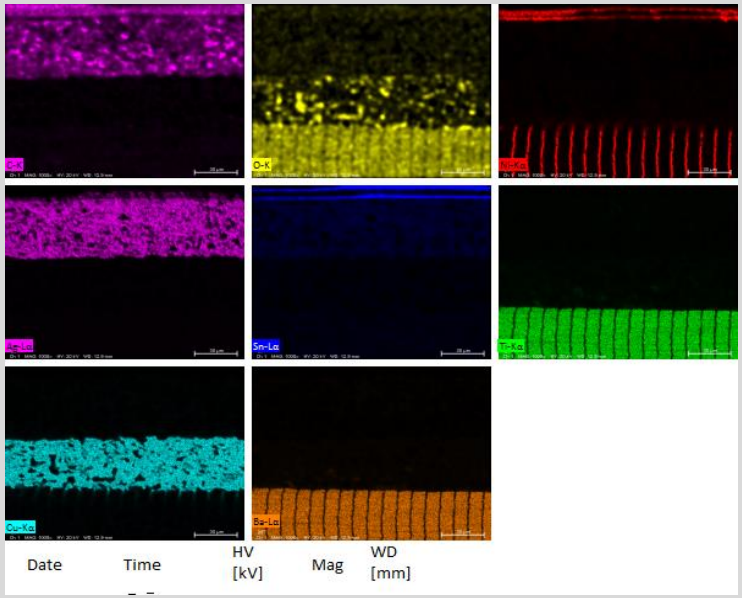




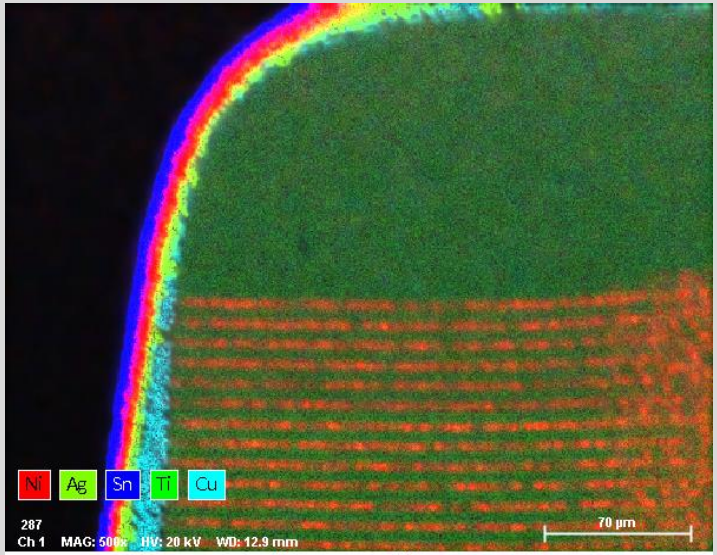
Sample preparation of EDS



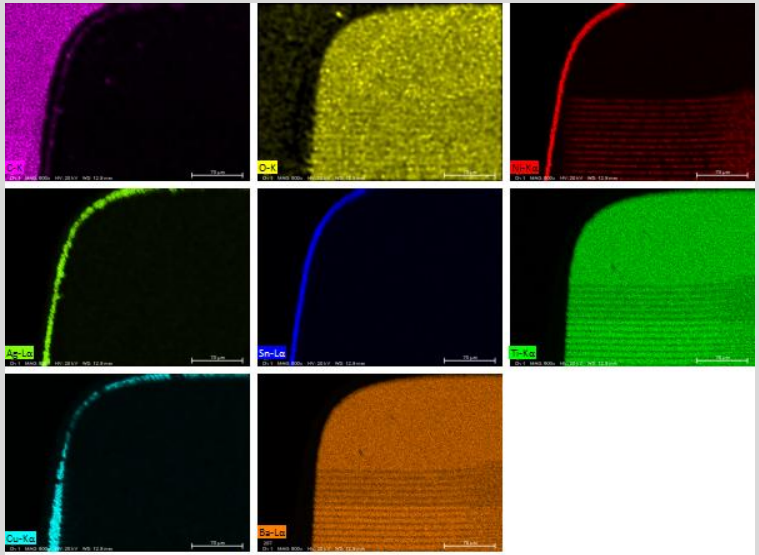
Name	Date	Time	HV [kV]	Mag	WD [mm]



Date	Time	HV [kV]	Mag	WD [mm]

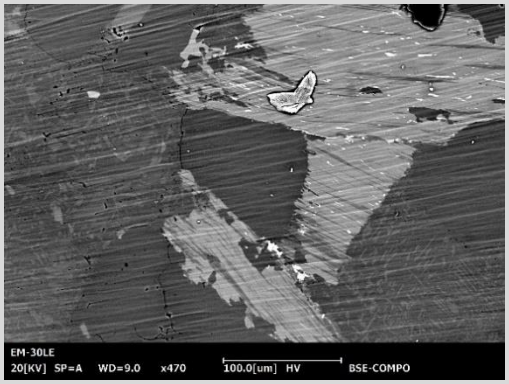


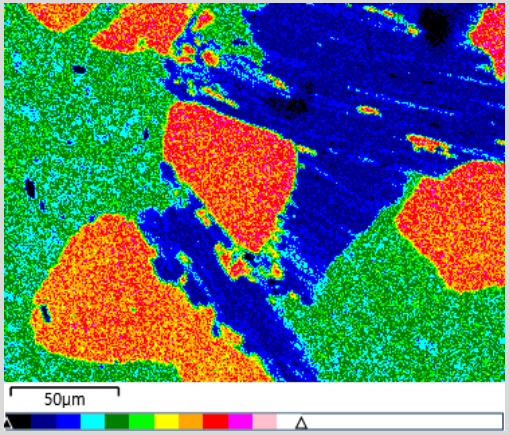
Name	Date	Time	HV [kV]	Mag	WD [mm]

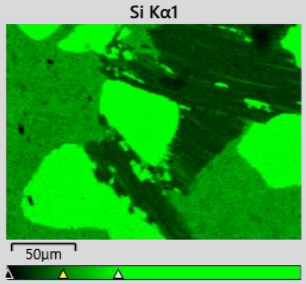


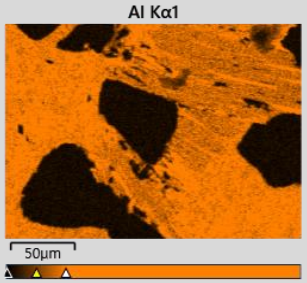
Date	Time	HV [kV]	Mag	WD [mm]

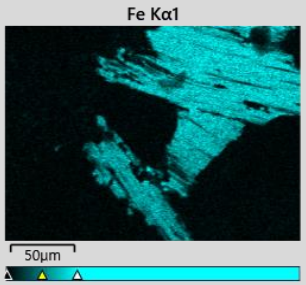
Sample preparation of EDS

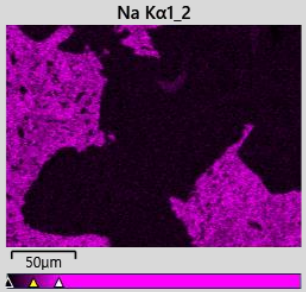


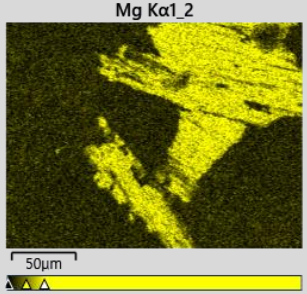


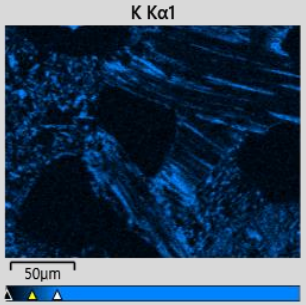


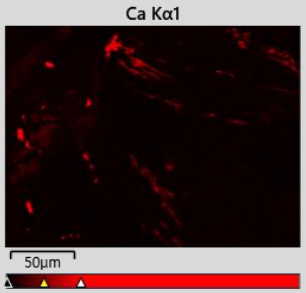


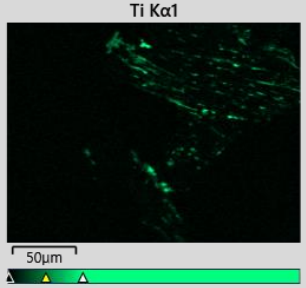






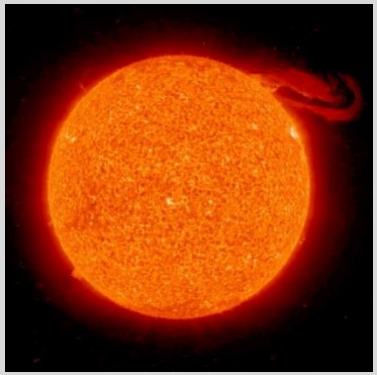






II. Nettoyeur Plasma

Plasma, what is it?

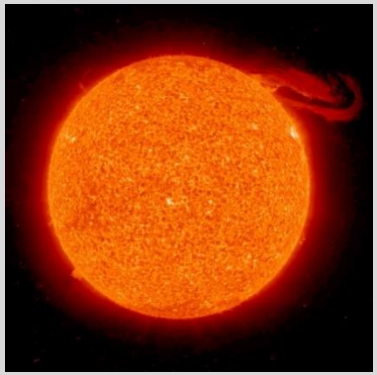


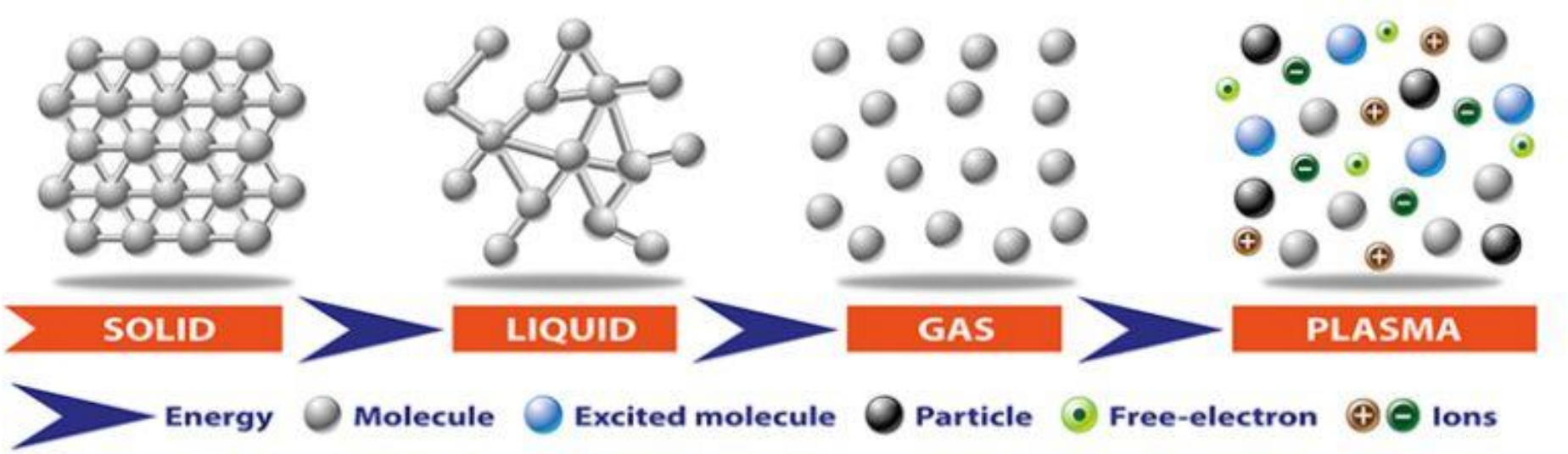
Solid – Liquid – Gas – Plasma

In Plasmas some electrons become free and at very high temperature (sun for instance) all electrons are free

plasmas are electrically conductive, produce magnetic fields and electric currents, and respond strongly to electromagnetic forces.

Plasma, what is it?





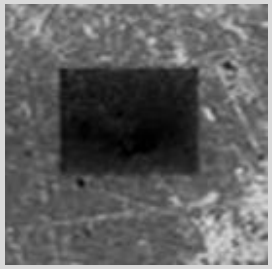
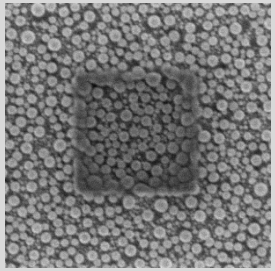
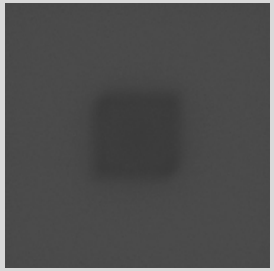
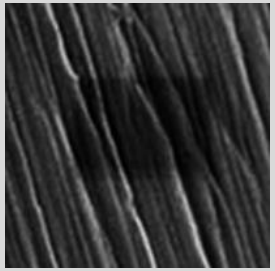
Plasma, What for?

- plasma displays, including TV screens
- Inside fluorescent lamps (low energy lighting), neon signs
- Fusion energy research
- Electric arc in an arc lamp, an arc welder or plasma torch
- Plasmas used in semiconductor device fabrication including reactive-ion etching, sputtering, surface cleaning and plasma-enhanced chemical vapor deposition

Plasma in Surface Science

- Coating (sputtering)
- Etching (Dry etching)
- Activation (improve wetting by increasing the surface energy)
- Cleaning

What caused those ugly scan mark in electron and ion microscope images?

Pump oil, vacuum grease, high vapor pressure polymer/photoresist samples introduce hydrocarbon contamination into sample chamber

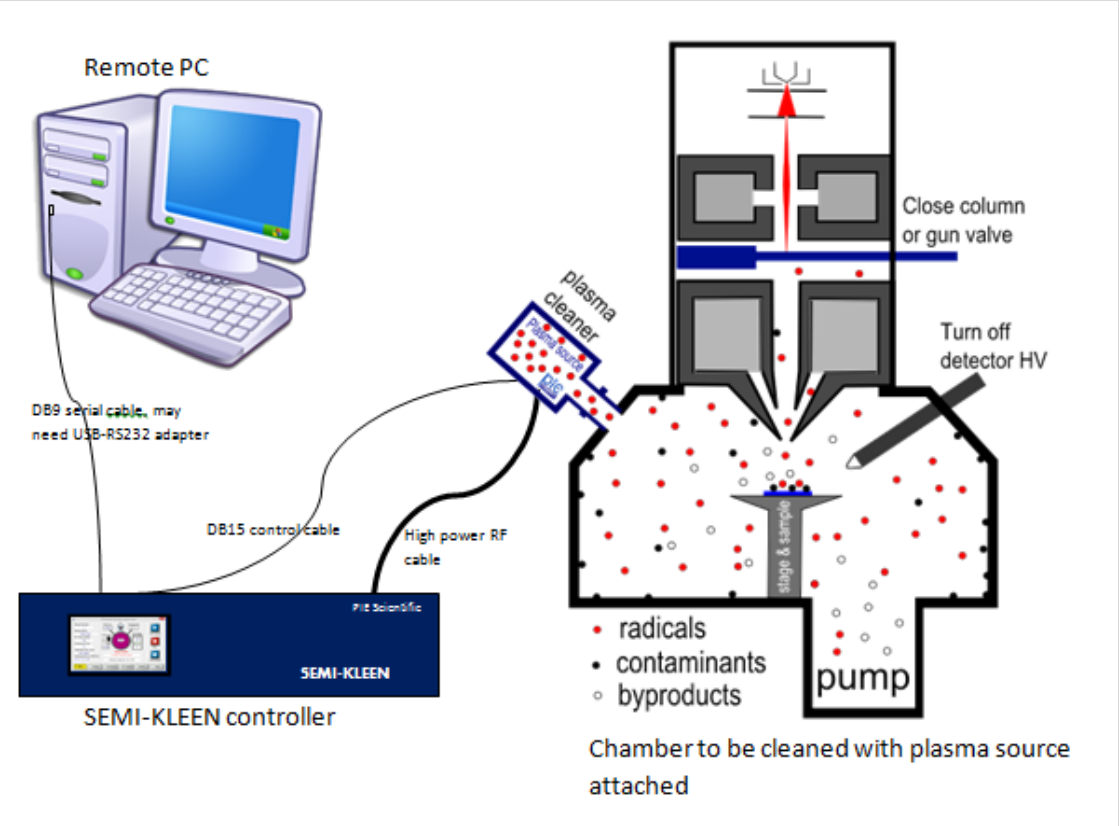
Low energy secondary electrons breaks down hydrocarbon molecules inside the chamber.

Carbon deposited around the scanned area. Due to relatively low secondary electron yield, carbon burn mark usually looks darker.

Impact of hydrocarbon contamination

- Reduces material contrast and resolution.
- May artificially increase carbon composition in EDX.
- Deposition on column aperture can create beam current instability, reduce electron optics resolution.
- Deposition inside electron optics column can cause beam drift in slow scan, focus instability and increase aberrations.

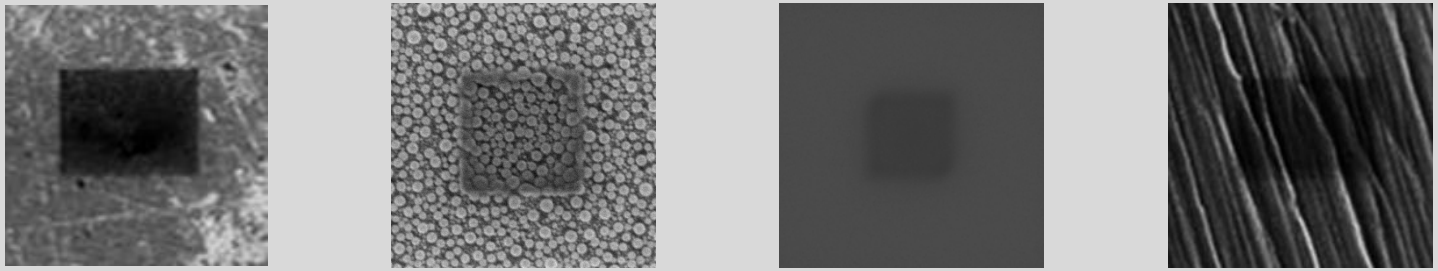
How to clean hydrocarbon contaminant in a vacuum environment?



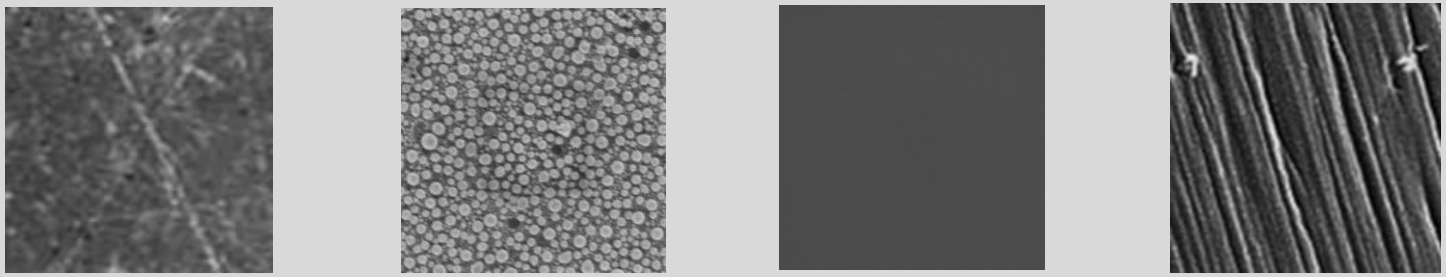
- Generate Air, O2+Ar or Hydrogen plasma inside plasma source
- Radical species (O, O3, OH, H) diffuse into sample chamber
- Radicals react with hydrocarbon molecules and generate high vapor pressure by-products
- By-products are then pump away by vacuum pumps

Effect of plasma cleaning

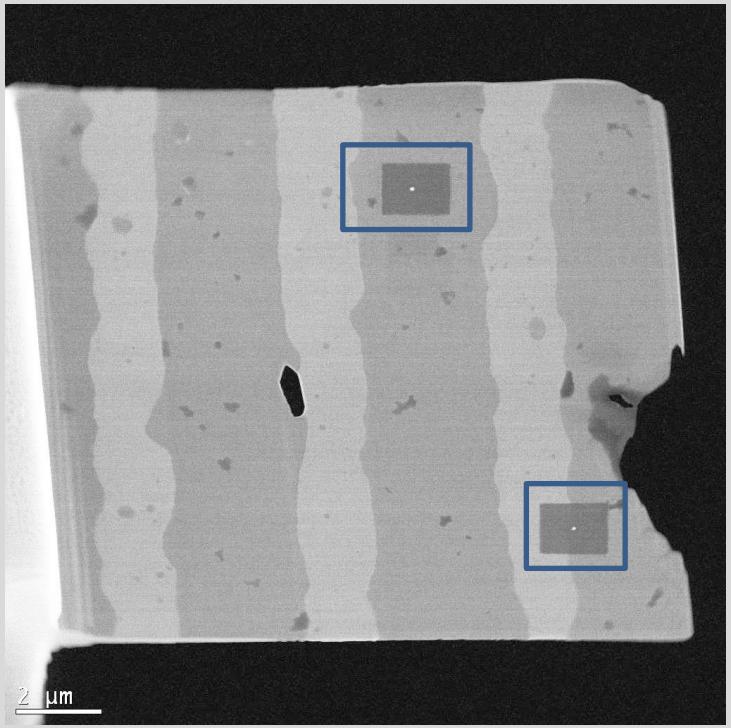
Before plasma cleaning



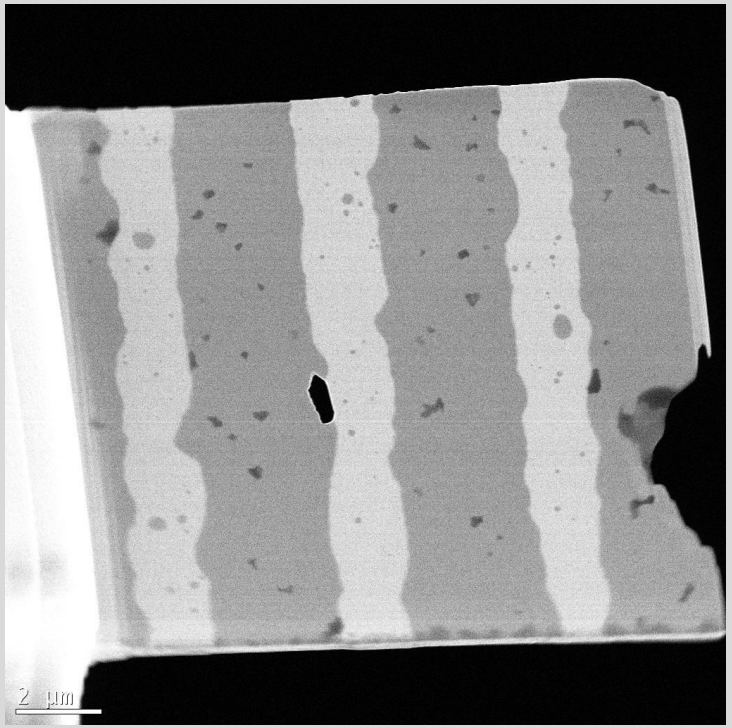
After plasma cleaning



TEM samples before and after plasma cleaning



Before cleaning



After 1 minute cleaning

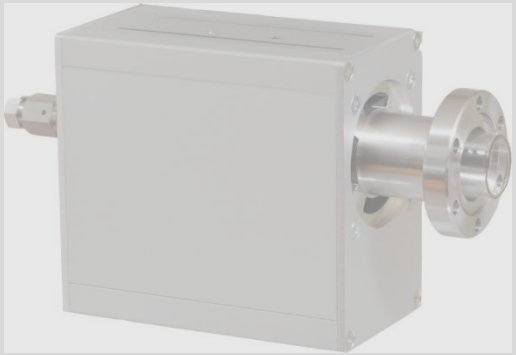
Remote plasma cleaners

EM-KLEEN

For hydrocarbon (HC) contamination cleaning on SEM, FIB, TEM, XPS, SIMS, AES

SEMI-KLEEN Quartz

Contamination removal on semiconductor equipment, such as EBI, EBR, CD-SEM, deposition systems. Also applicable for SEM, FIB, TEM



SEMI-KLEEN Sapphire

For generating aggresive & corrosive gas plasma, such as hydrogen, NH3, NF3, CF4, etc. For contamination removal on deposition system.

Touch screen controllers

75W Portable tabletop controller

75W or 150W 3U rack mount controller.
Side mounting hole options available.

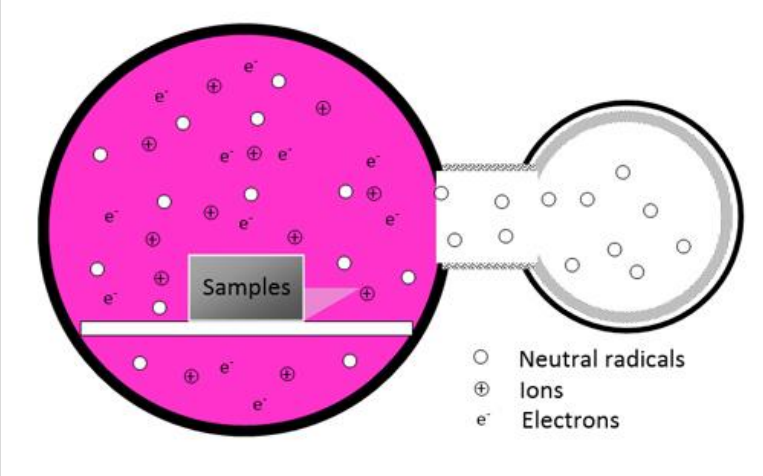
Tergeo-EM plasma cleaner

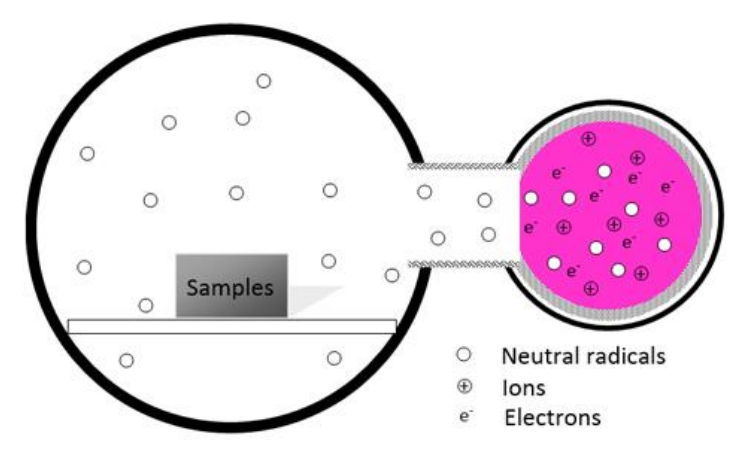
TEM rod adapter with cap

1. Integrated **direct/immersion** and **remote/downstream** cleaning modes
2. **Plasma sensor** for real time plasma intensity measurement
3. **Pulsed operation** for millisecond short pulse .
4. All-in-one laboratory plasma etching, treatment and cleaning system.
5. Large sample chamber for batch processing. Quartz tube ID:110mm, depth 280mm, with a rectangular quartz sample tray (100mmX250mm) to hold batch of samples.
6. Dual TEM rod adapter, can be configured to support TEM rods from two different vendors.

Direct & downstream cleaning modes

The only plasma cleaner that can support two modes in one system!





Direct mode plasma cleaning

Plasma is generated in the sample chamber.
Samples are immersed in plasma
Samples are subject to chemical reaction with radicals and energetic ion sputtering.
Used for high speed photoresist ashing, etching and sample surface treatment.

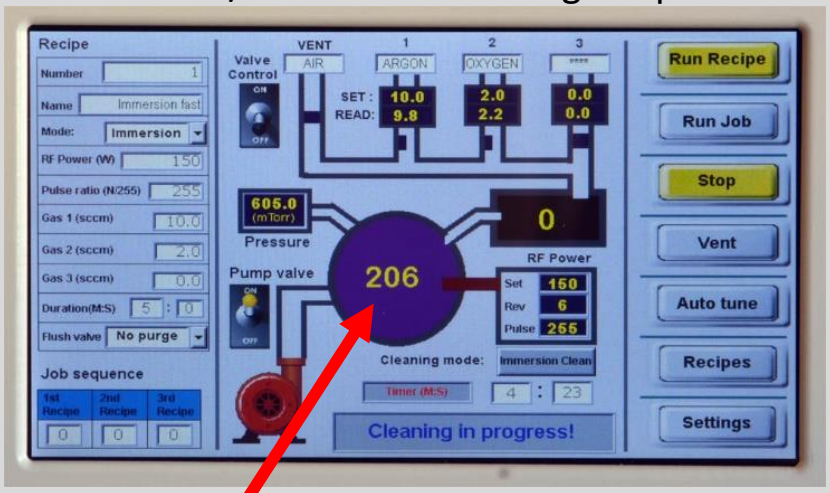
Downstream mode plasma cleaning

Plasma is generated outside sample chamber.
Samples are not immersed in plasma
Only gentle chemical reaction takes place on the sample surface. No energetic ion sputtering!
Used for fragile thin film such as holey carbon TEM grid and heat sensitive composite, polymer and biological samples, etc.

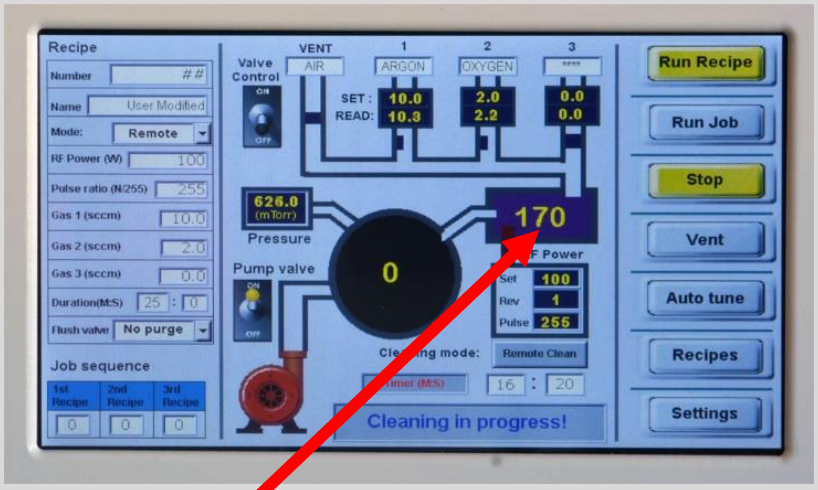
Quantitative plasma intensity measurement

The only tabletop plasma cleaner that can measure the plasma intensity

Direct/Immersion cleaning recipe



Remote/Downstream cleaning recipe



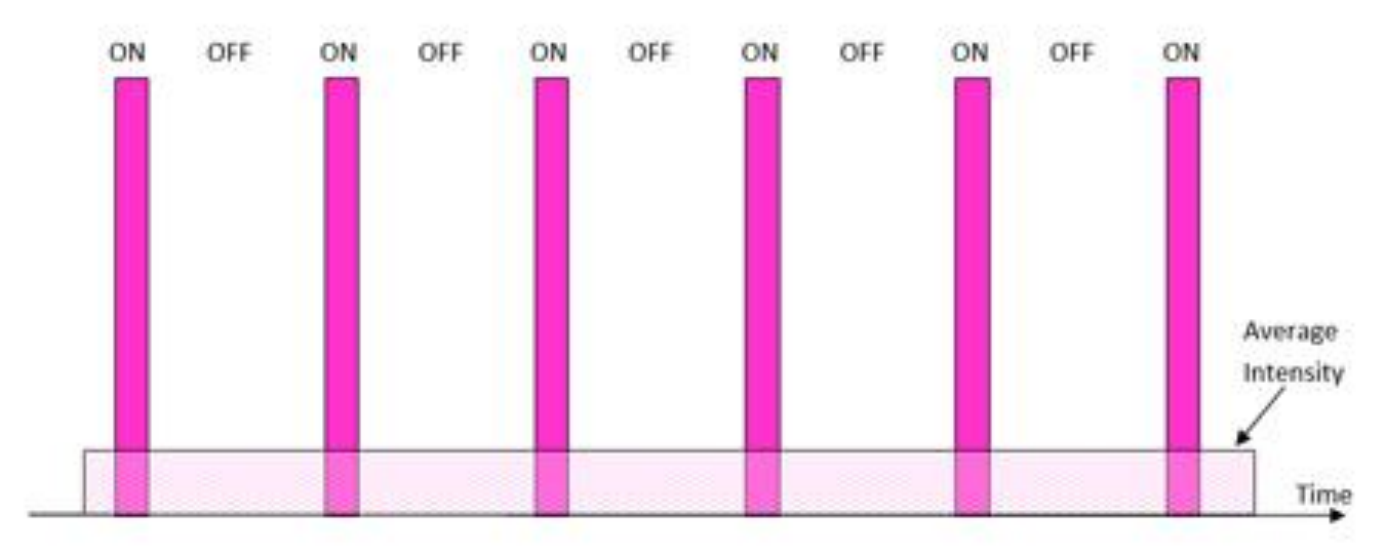
Plasma generated in the sample chamber. Plasma intensity reading is 206

Plasma generated in the remote plasma source. Plasma intensity reading is 170

-To know exactly how strong the plasma is.
-To use the quantitative plasma intensity measurement as the feedback to adjust the gas flow rate and the RF power for desired cleaning speed.
-No need to be a plasma expert to set up right cleaning recipes for different samples.

Pulsed mode operation

The only tabletop plasma cleaner that can pulse the plasma



Low duty cycle pulsed mode operation can significantly reduce average plasma intensity for delicate samples.
User can adjust plasma intensity by changing rf power wattage and/or rf pulsing duty cycle.

All-in-one laboratory plasma cleaner

- Don’t choose between a TEM/SEM plasma cleaner with a very small chamber OR an ordinary tabletop plasma cleaner for high speed etching and surface treatment. Tergeo-EM is designed to be an all-in-one laboratory plasma cleaner.

  - High-speed sample cleaning, such as heavily contaminated SEM/TEM samples
  - photoresist ashing
  - ion sputtering treatment (cleaning before wire bonding, etc)
  - high-speed sample surface modification
  - other high speed etching applications
  - TEM holey carbon grid, heat and ESD sensitive devices, graphene, etc

Advanced Technology for fragile or delicate SEM/TEM samples

- Why Tergeo-EM can easily process fragile and heat sensitive samples:
  - **Smart plasma ignition algorithm because of the unique plasma sensor technology**.
    - plasma sensor that can measure the plasma intensity in real-time.
    - If the plasma fails to ignite at low RF power setting, the system will automatically increase the RF power until the plasma ignites.
    - After ignition, the system will immediately reduce the RF power to the recipe setting.

    → **Tergeo-EM can operate at much lower RF power.**
  - **Downstream** and direct mode in one system.
    - Downstream mode for gentle processing method
  - **Pulsed mode operation.**
    - Pulsed mode operation can reliably generate extremely weak plasma with average power less than 0.25 watt.

Intuitive design and easy to use

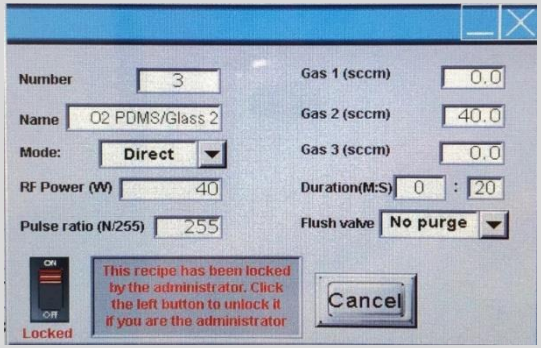
- Two different user interface: LCD touchscreen user interface and PC remote control user interface.
- Intuitive user interface. Easy to use. No extensive training required.
- Fully automatic operation. Supports 60 recipes. One button to start. Repeatable and reliable results.
- Recipe lock/unlock function to prevent unintended modification of the optimized recipes. Essential features for repeated runs and for shared facility.

Supports total 20 recipes

Page 1 | Page 2 | Edit Recipe | Load Recipe | Main Screen

#	Recipe Name	Mode Selection	Power (Watt)	Duty Ratio	Gas 1 (sccm)	Gas 2 (sccm)	Gas 3 (sccm)	Duration (M:S)	Purging Gas	Tuned? (Y/N)
1	Pure Argon	Immersion	150	255	3.0	0.0	0.0	2 : 0	No	Yes
2	Pure Oxygen	Immersion	150	255	0.0	2.0	0.0	2 : 0	No	Yes
3	Low power mix	Immersion	25	255	5.0	2.0	0.0	2 : 0	No	Yes
4	Medium pow. mix	Immersion	75	255	5.0	2.0	0.0	2 : 0	No	Yes
5	High pow. mix	Immersion	150	255	2.0	2.0	0.0	2 : 0	No	Yes
6	Remote mix MP	Remote	75	255	5.0	2.0	0.0	2 : 0	No	No
7	Remote MIX HP	Remote	150	255	20.0	3.0	0.0	2 : 0	No	No
8	Remote O2 HP	Remote	150	255	0.0	2.0	0.0	2 : 0	No	No
9	Remote Ar LP	Remote	25	255	10.0	0.0	0.0	2 : 0	No	No
10	Low power O2	Immersion	25	255	0.0	1.0	0.0	2 : 0	No	Yes

Recipe can be locked after optimization



Tergeo-EM highlight

1) **Dual plasma sources design** can meet requirements for different samples.
   1)Remote mode is gentle enough to handle 3nm ultra-thin holey carbon grid.
   2)Direct mode can be strong enough to remove more than several micron thick layer of organic contamination.

2) **Pulsed plasma technology** can generate extremely weak plasma
   1) for extremely thin holey carbon grids. 0~75Watt or 0~150W 13.56MHz rf power supply with automatic impedance matching.
   2)Continuous or pulsed plasma, cycle time: 2ms. Pulse ratio: 0.4% to 100%

3) **Unique plasma intensity sensor** quantitatively monitors the plasma intensity. User can adjust the plasma accordingly for different kind of samples.

4) MEMS based **pressure sensor** technology constantly monitor plasma chamber and SEM chamber pressure.

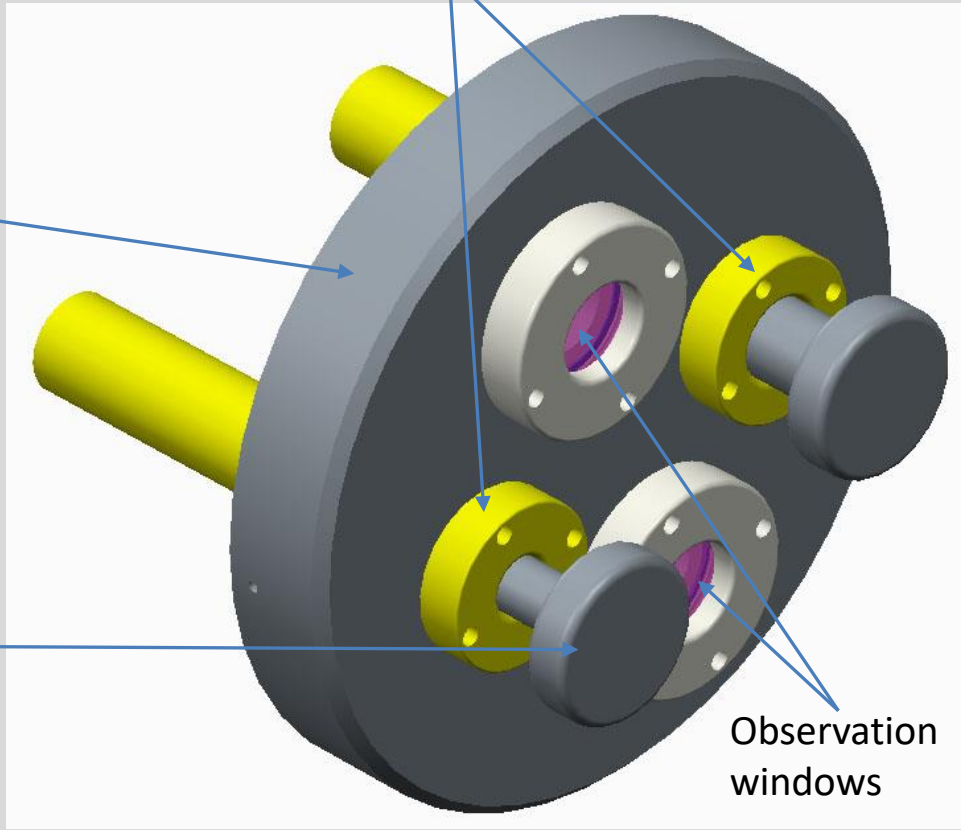
5) Can clean SEM and TEM sample **simply with room air.** Also support single or mixed gas from argon, oxygen and hydrogen.

Supports multiple TEM systems with one plasma cleaner

Two TEM rod adapter can be configured to support two different TEM rods

The front adapter cap can be easily replaced, if the user facility has more two different kinds of TEM sample holders, the third and the fourth TEM sample holder can be installed on the second cap assembly.

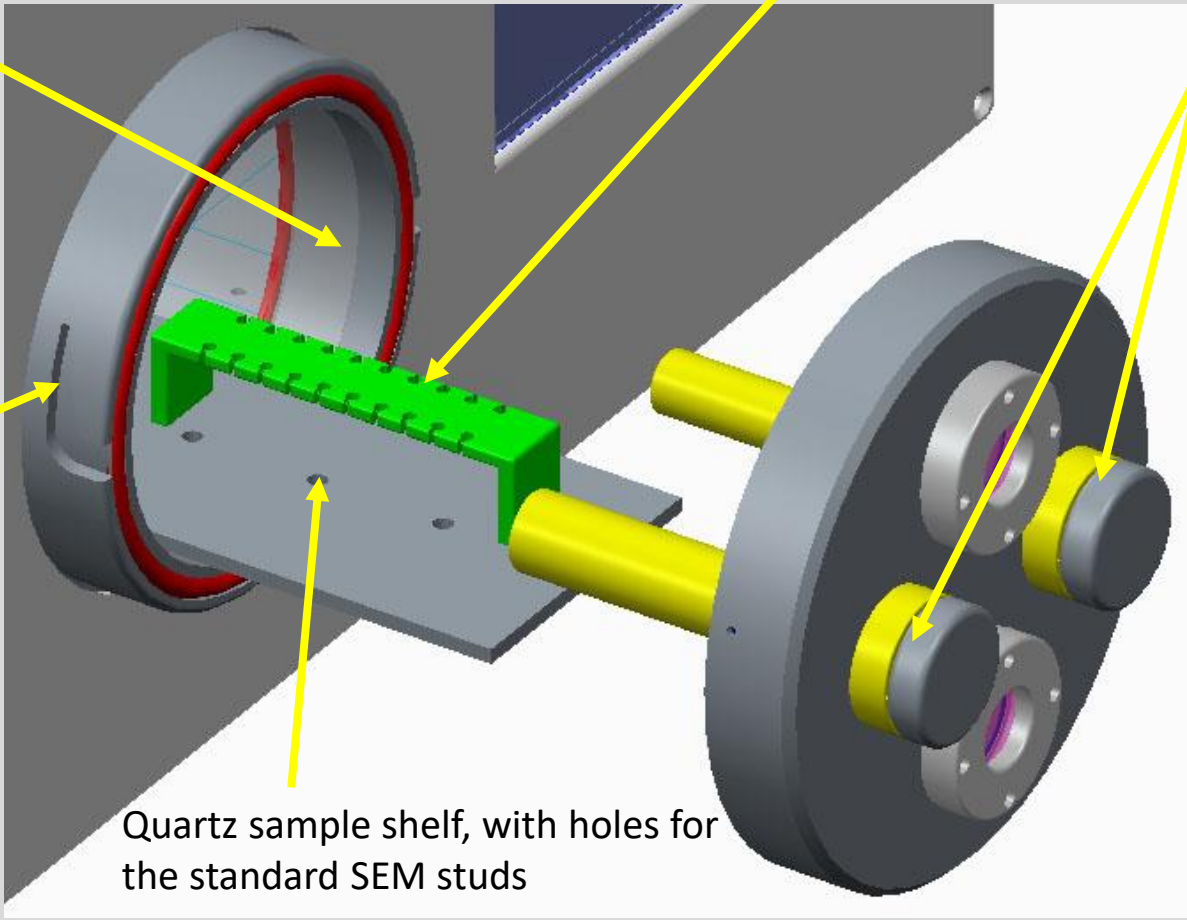
Cap for vacuum seal when the TEM rod is not inserted.



Sample loading methods

Quartz sample chamber.
ID:110mm, depth: 280mm

20 TEM sample holder. It can be placed directly on the quartz shelf. Can hold up to six pieces of the holders (120 grids) in the chamber



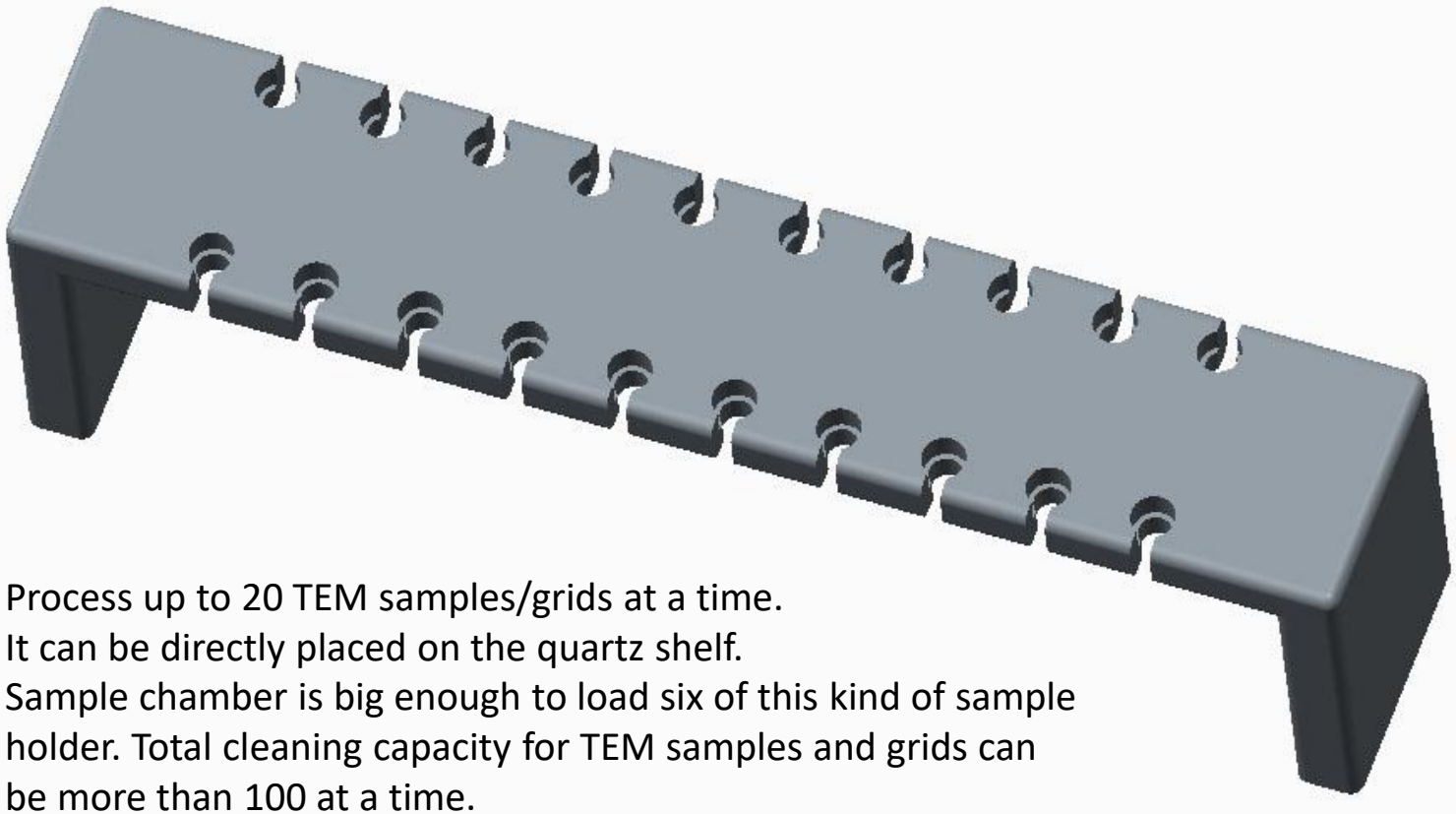
Clean two TEM sample rods at a time. Simply take the cap out and insert the TEM rods

Front door locking groove. Door is firmly locked on the chamber during the normal operation

Quartz sample shelf, with holes for the standard SEM studs

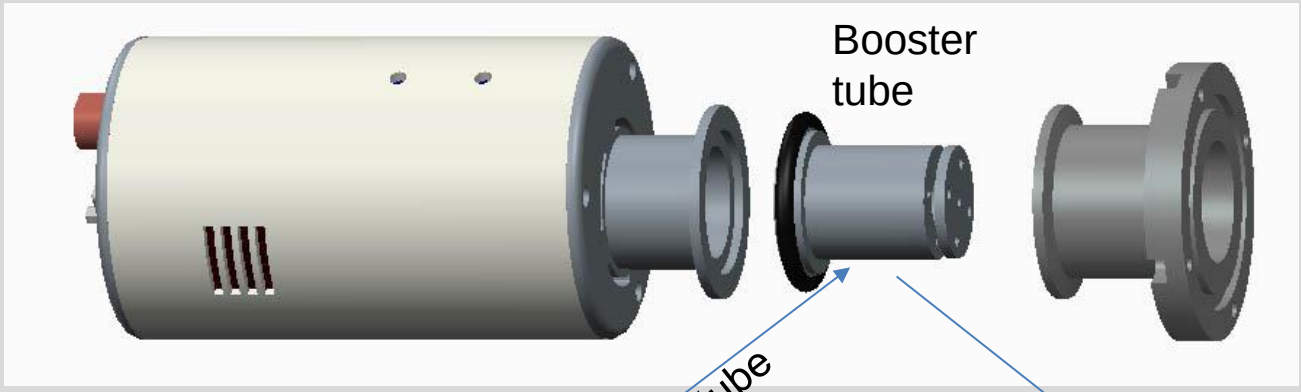
Front door can be taken out to access the large sample chamber.

20 TEM sample holder

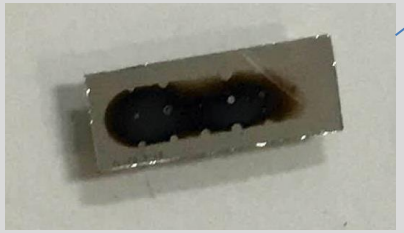


Process up to 20 TEM samples/grids at a time.
It can be directly placed on the quartz shelf.
Sample chamber is big enough to load six of this kind of sample holder. Total cleaning capacity for TEM samples and grids can be more than 100 at a time.

Special high speed SEM sample and aperture cleaning mode

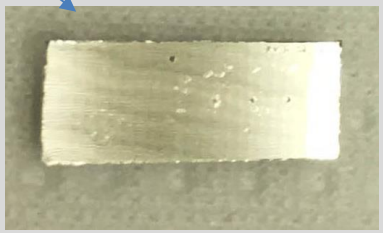


SEM aperture strip contaminated with hydrocarbon deposition



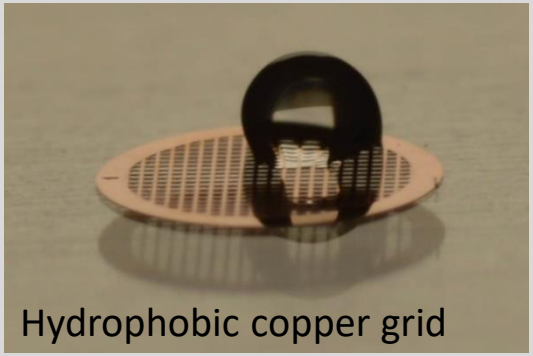
Place in booster tube

After 10 minute cleaning inside the booster tube

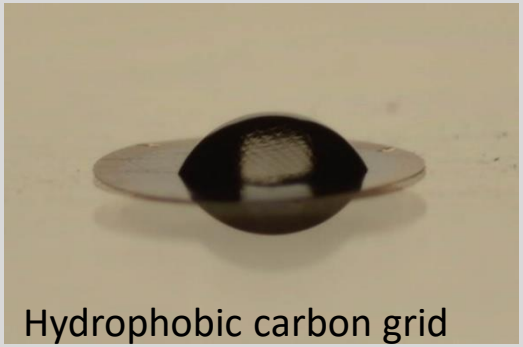


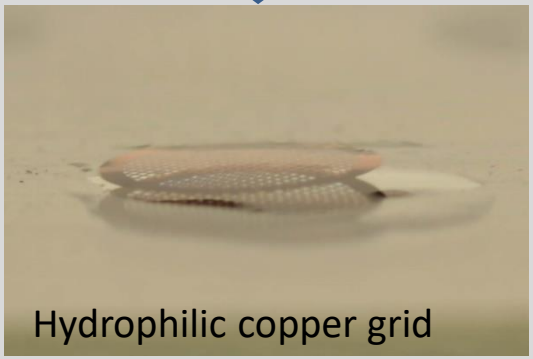
Recycle contaminated apertures. No need to spend thousands of dollars to buy new ones!

Making TEM grid hydrophilic for cryo-EM applications

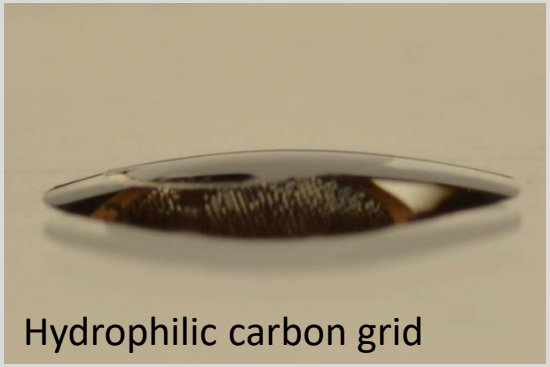

Hydrophobic copper grid

TEM grids are usually hydrophobic before plasma processing


Hydrophobic carbon grid

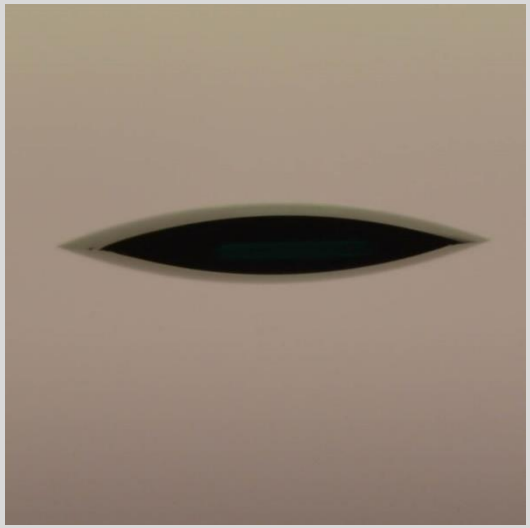

Hydrophilic copper grid

TEM grids completely immersed in water droplets after plasma processing


Hydrophilic carbon grid

Making in-situ holder hydrophilic

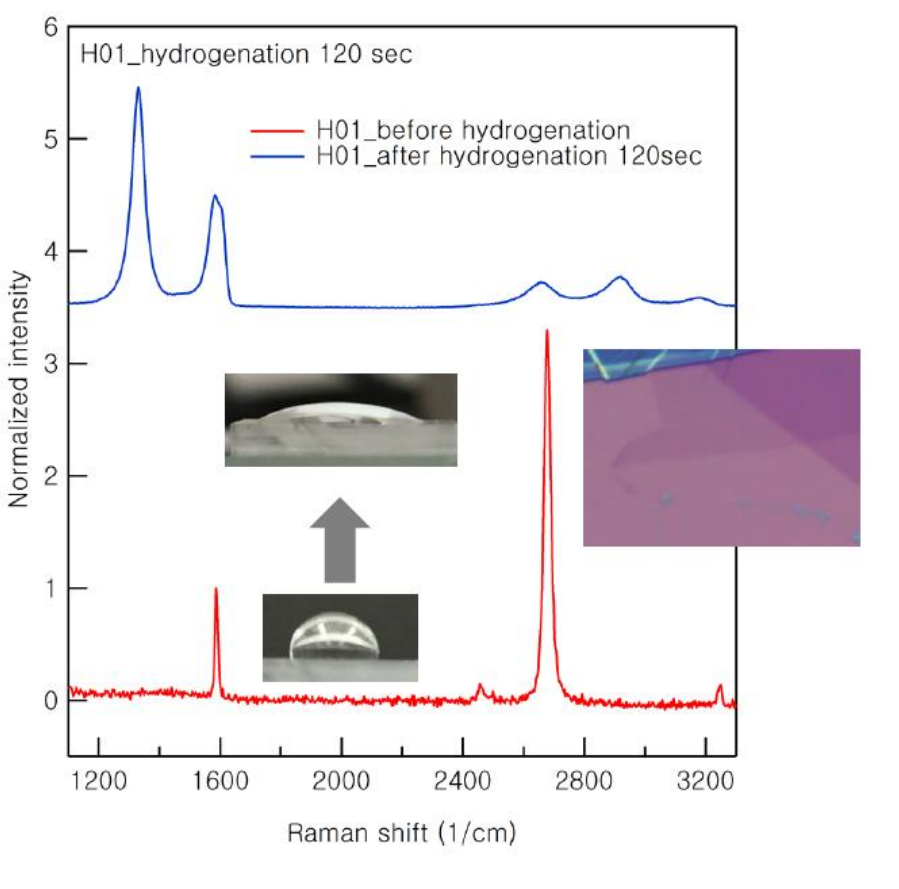
Silicon Nitride Surface used on in-situ chips



Before cleaning:
contact angle 23.5 degree

After 1 minute cleaning:
contact angle 2.8 degree

Hydrogenation of graphene



Recipe: Remote mode, 10W rf power, 5sccm gas (H2:Ar 2%:98%, buffered, non-explosive gas)

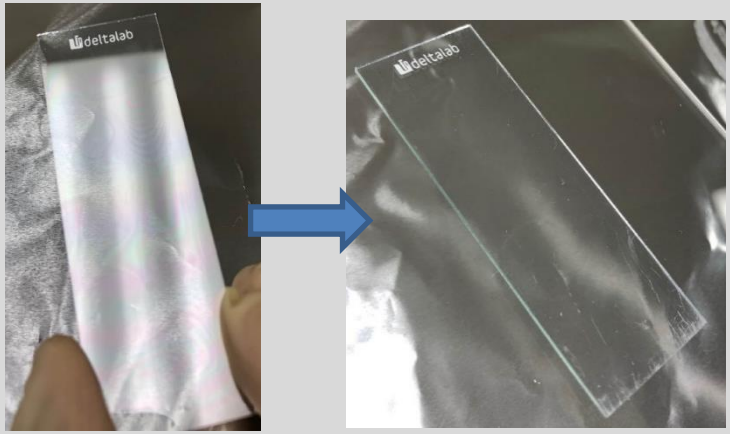
After 2 minutes, the hydrophobic graphene was changed to hydrophilic hydrogenated graphene. The Raman spectrum confirmed hydrogenation results.

Courtesy of Dr. Jangyup Son at Professor Arend M. van der Zande Group in UIUC

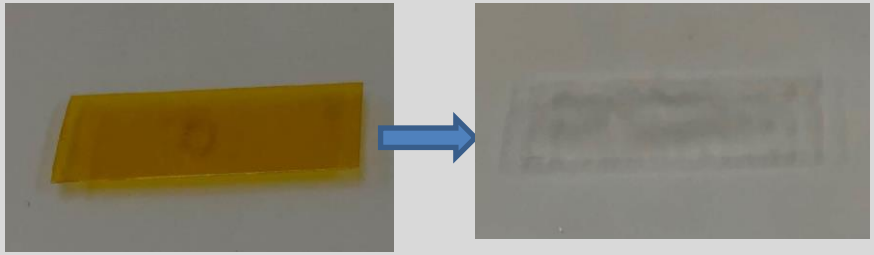
Decapsulation for SEM failure analysis

1. Remove parylene conformal coating in PCB failure analysis with oxygen plasma
2. Remove polyimide capping layer with oxygen
3. Remove nitride and oxygen capping layer with CF4+O2 plasma

Remove 5um parylene coating on a glass slide test sample in 20 minutes



Kapton tape (25µm) polyimide film over 75µm silicone adhesive)
25um polyimide film is mostly remove after 3-4 hours of oxygen plasma. Only the silicone adhesive layer remained.

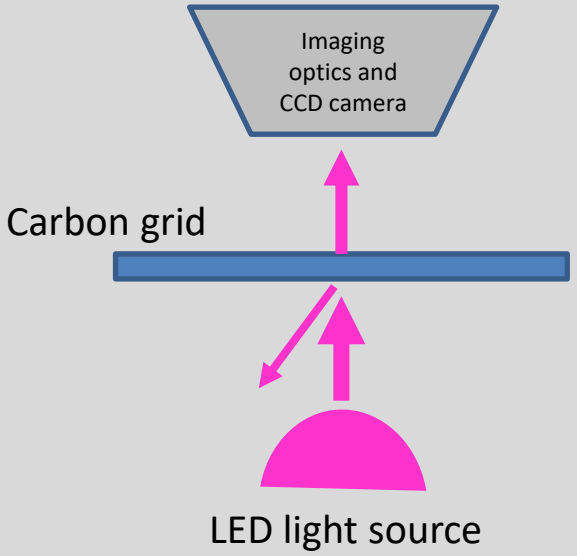


TEM carbon grid cleaning evaluation

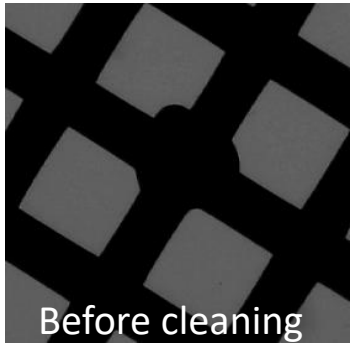
Gentle **downstream** cleaning mode and **pulsed plasma**.

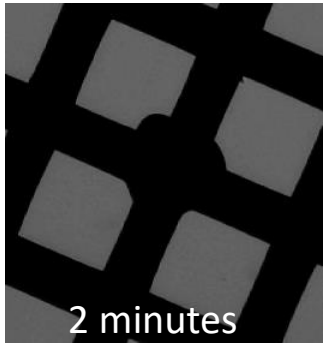
What happens when the carbon grid is imaged at an transmission optical microscope

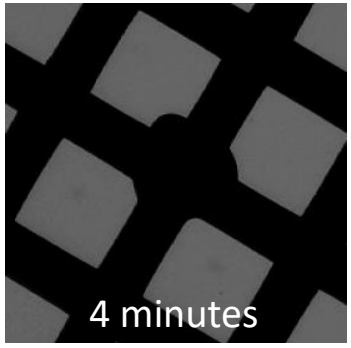
1) Reflection at the bottom surface of the carbon grid.
2) Absorption within the carbon grid.
3) Remaining light is transmitted and collected by the imaging optics and the CCD camera.
4) Transmitted light is an indicator of the thickness of the carbon grid.

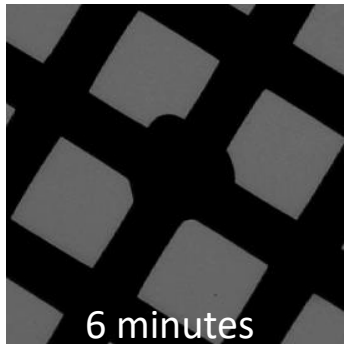


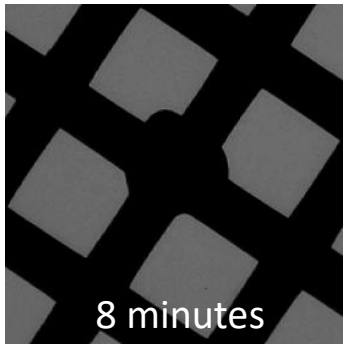
Ted-Pella 20nm pure carbon grid (01843)

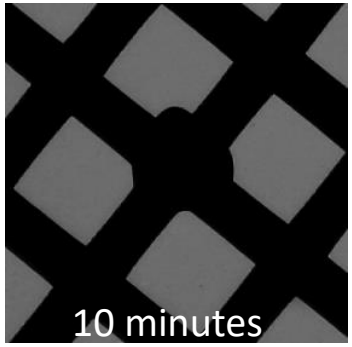


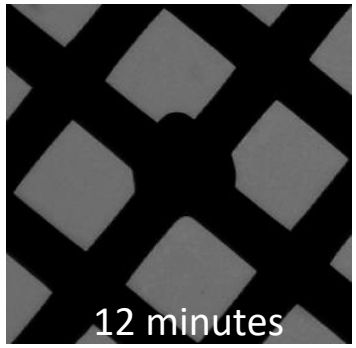


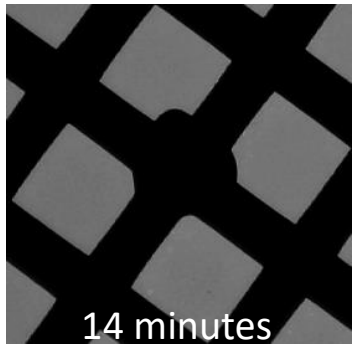


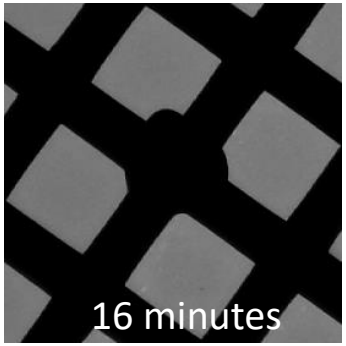


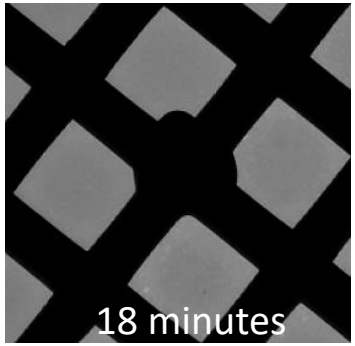


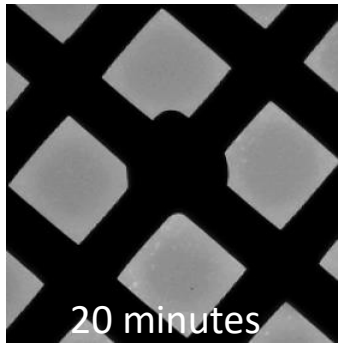


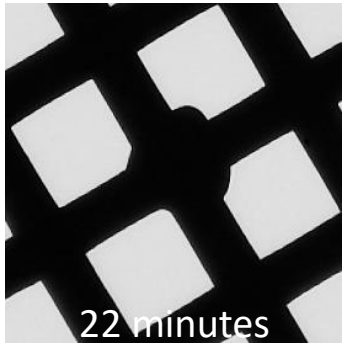






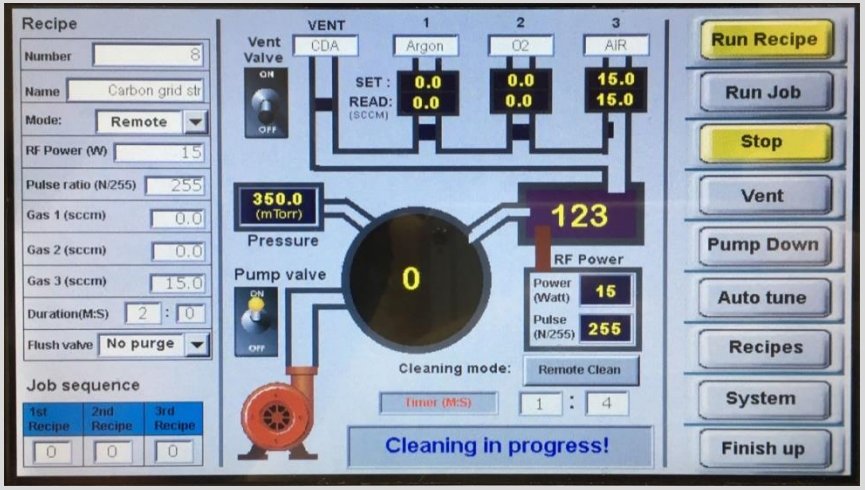


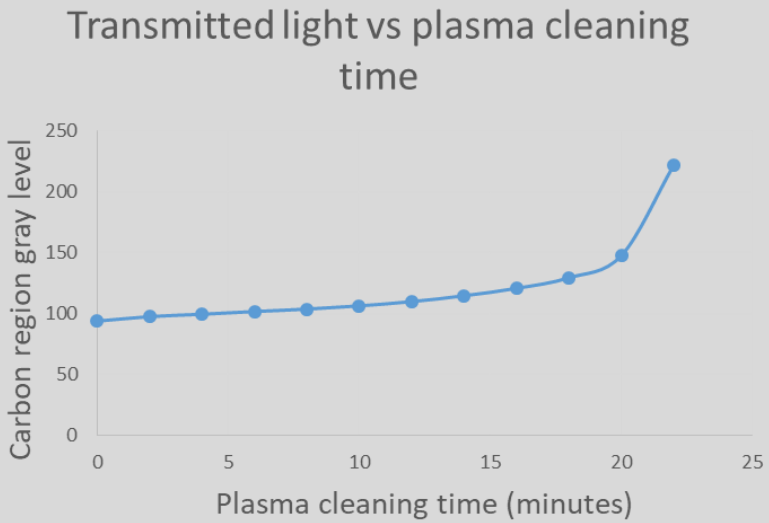




Ted-Pella 20nm pure carbon grid (01843)

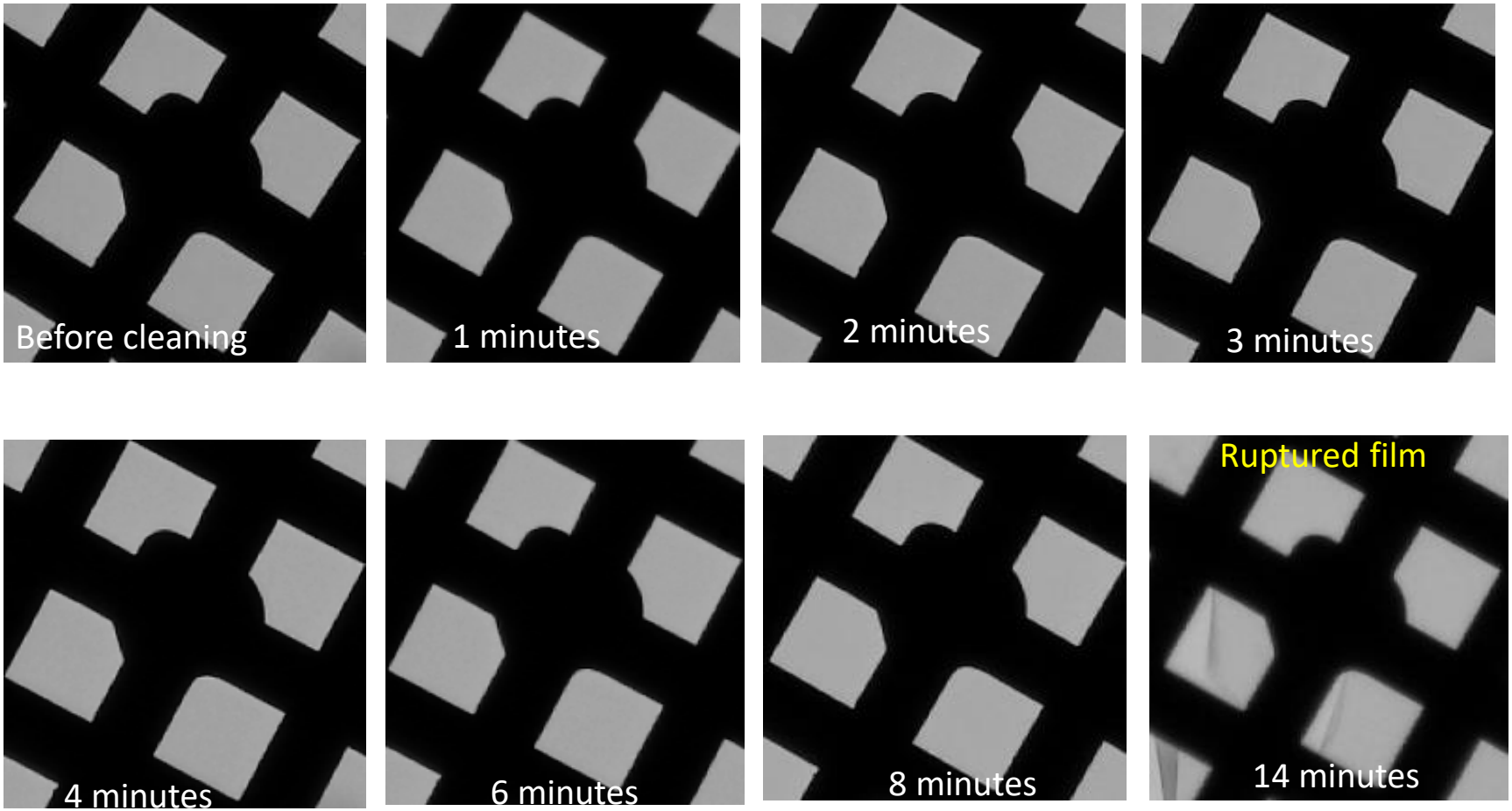
Carbon grid cleaning recipe using room air





- Ted-Pella 01843 pure carbon film has no Formvar layer. Thickness is about 15~25nm.
- Plasma recipe: **downstream mode**, 15 watt rf power, 15sccm air, pulse: full duty ratio. **Intensity reading: 123**
- **After 22 minutes plasma cleaning, the carbon film is totally etched away. Assuming the etching rate is constant, then the etching speed is about 1nm per minutes.**
- The fast rising of the transmitted light after 18 minutes of plasma etching might be because of the reduction of the reflected light when the holes starts to form in the film.

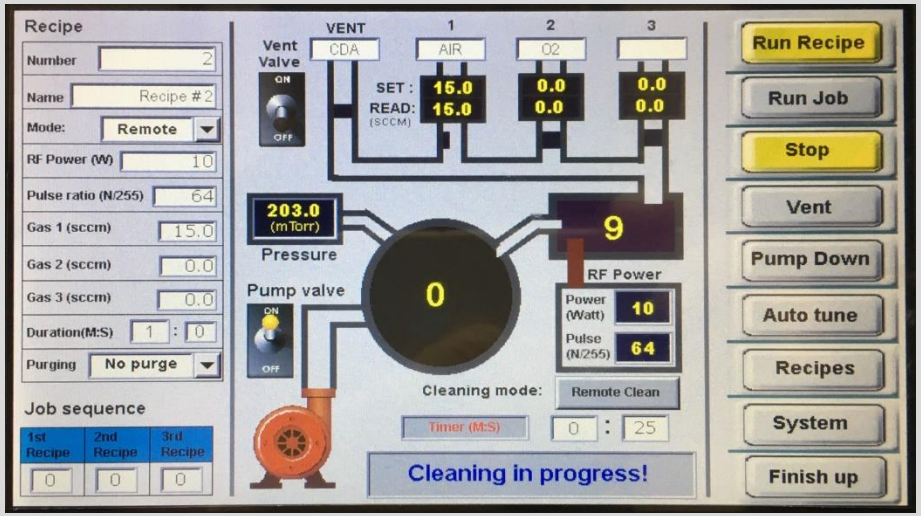
Ted-Pella 3nm ultrathin Lacey carbon

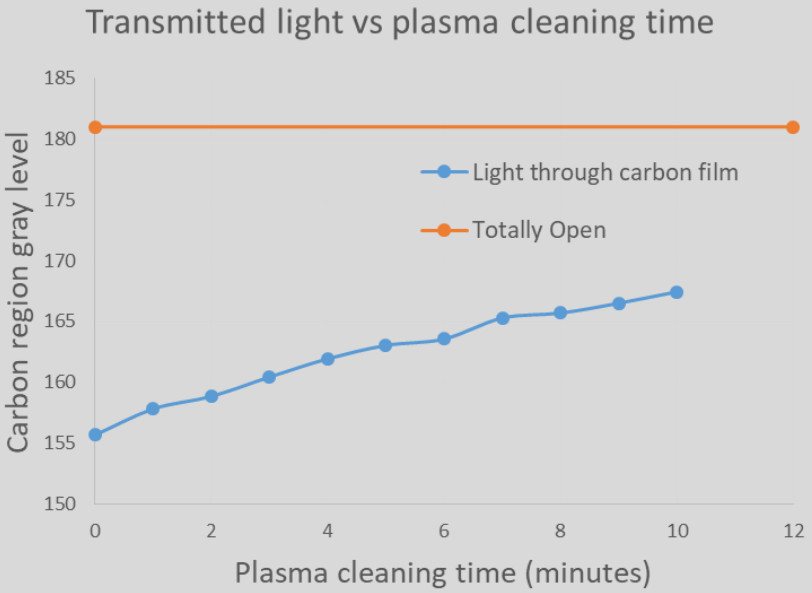


Starts to observe film ruptures in some areas after 8 minute of plasma cleaning. After 14 minutes of plasma cleaning, film starts to rupture in the center area

Ted-Pella 3nm ultrathin Lacey carbon

Carbon grid cleaning recipe using room air





- Ted-Pella 01822 3nm ultra-thin Lacey carbon film. Thickness is about 3nm.
- Plasma recipe: **downstream mode**, 10 watt rf power, 15sccm air, pulse: 64/255 (e.g. ¼ duty ratio). **Intensity reading: 9.** Extremely weak downstream plasma is required for ultra-thin Lacey carbon film.
- **After 8 minutes plasma cleaning, some area of the film starts to rupture. After 14 minute of plasma cleaning, the center area of the film starts to rupture even though the film is not totally etched away.**

Conclusion on carbon grid processing study

- With the **downstream** cleaning mode and the **pulsed plasma**, Tergeo-EM can gently clean fragile TEM carbon grid.
- For regular 20 nm carbon film: fairly easy to clean the sample grid for multiple times.
- For 3 nm ultra-thin carbon grid, it's possible to clean it multiple times at 10 watt rf power and pulse ratio of 1/4.
- **Plasma intensity sensor** measures the plasma intensity in real-time. It helps the user set up the recipe for different samples.
- Even though Tergeo-EM can support oxygen, hydrogen and argon gas, it is sufficient to clean fragile carbon grid with only **room air** on Tergeo.
- Tergeo-EM is very versatile. The etching speed can be easily increased or decreased though the combination of direct/downstream mode, RF power and pulse ratio.

Related product

Multi-purpose chamber to extend the function of EM-KLEEN plasma source.

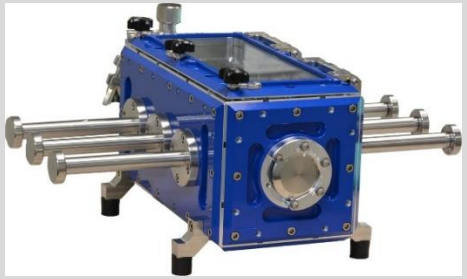
Plasma cleaning chamber for SEM and TEM samples. It can also be used as specimen holder vacuum storage chamber.

Configurations for Multi-purpose chamber

Configuration 1:
Vacuum chamber with EM-KLEEN plasma source.
Clean SEM and TEM sample placed inside the vacuum chamber with EM-KLEEN plasma source.

Configuration 2:
Vacuum chamber with six TEM specimen holder adapters and EM-KLEEN source.
Can clean the samples inside the chamber or on the specimen holder. Store up to six specimen holders under vacuum to keep them dry and clean.

Configuration 3:
Vacuum chamber with six TEM specimen holder adapter.
Store up to six specimen holders under vacuum to keep them dry and clean.



User can take out the EM-KLEEN plasma source and install it on SEM and FIB chambers

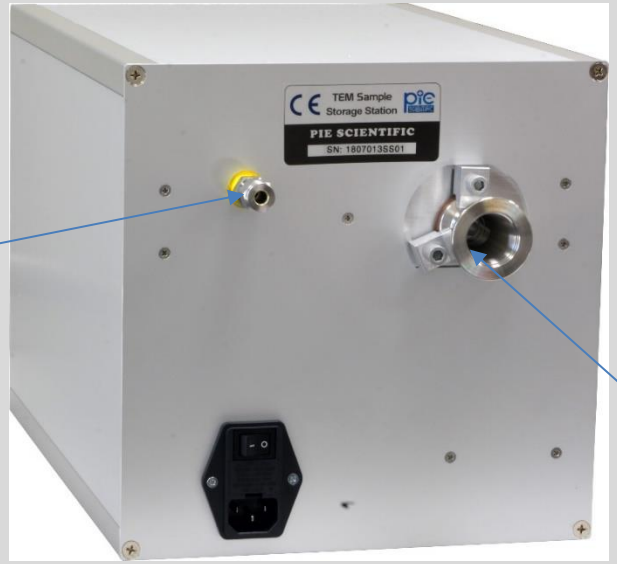
TEM sample holder storage system

Front side

Storage cells with cap. It can be mix-matched from FEI, JEOL and Hitachi sample rods

Solenoid valve control button. Blue light means in vacuum. Light off means vented

Back side



Venting gas port, can be dry clean argon or nitrogen

Pumping port. Can be NW25 or NW40

Thank you !

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