CIQTEK

FIB Focused Ion Beam - Scanning Electron Microscope

DB550

Elegant and well-crafted

www.ciqtek.com

Introduction

DB550 is a Field Emission Scanning Electron Microscope with Focused Ion Beam column for nano-analysis and specimen preparation, which is applied with “Super Tunnel” electron optics technology-low aberration and magnetic-free objective lens design, with “Low-voltage & High-resolution” ability that ensures its nano-scale analytical capability.

The ion column facilitates a Ga+ liquid metal ion source with highly stable and high quality ion beam to ensure nano-fabrication capability. DB550 is equipped with an integrated nano-manipulator, gas injection system, and a user-friendly GUI software, which facilities an all-in-one nanoscale analysis and fabrication workstation.

Features

"Super Tunnel"
Electron Optics Technology

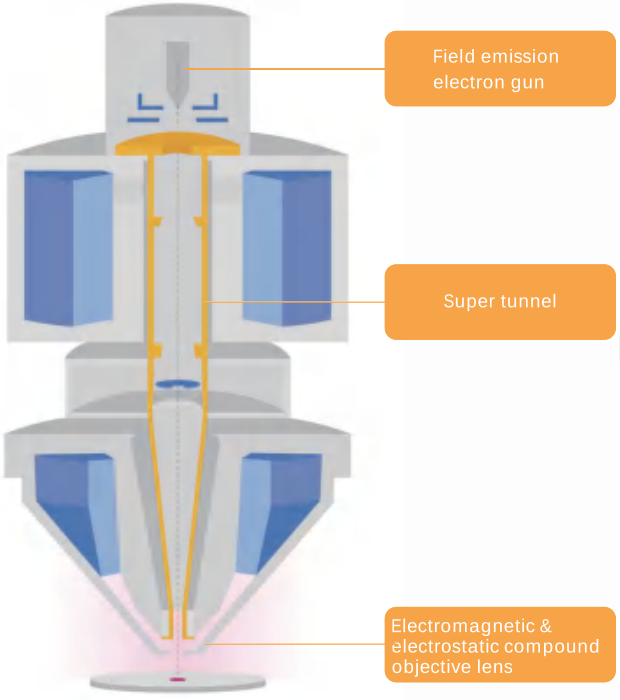
Gallium Ion Beam

Excellent Expandability

Integrated Gas Injection System

Integrated Nano-manipulator

Specimen Exchange Loadlock (8 inches compatible)



01

“Super Tunnel” electron optics column technology/in-column beam deceleration

Decrease spatial charging effect, ensuring low voltage resolution performance

02

Crossover free in the electron beam path

Effectively reduce lens aberrations and improve resolution

03

Electromagnetic & electrostatic compound objective lens

Reduce aberrations and significantly improve resolution at low voltages, and enable observation of magnetic samples

04

Water-cooled constant-temperature objective lens

Ensure the stability, reliability, and repeatability of the objective lens performance

05

Variable multi-hole aperture switching system by electro-magnetic beam deflection

Automatic switching in between apertures without mechanical motion, allowing fast switching amongst various imaging modes

Technical introduction

Focused Ion Beam Column

Features:

Resolution: 3 nm@30 KV

Probe current: 1 pA~65 nA

Accelerating voltage range: 0.5 KV~30 kV

Ion source exchange interval: ≥1000 hours

Stability: 72 hours uninterrupted operation

Nano-manipulator

Features:

Chamber internally mounted

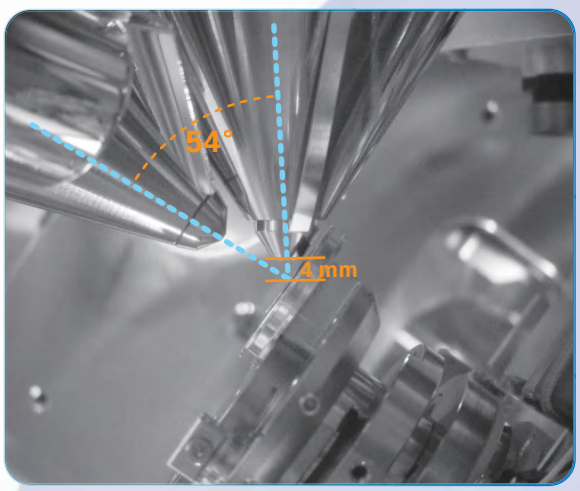
Three-axis all-piezoelectric driven

motion accuracy: ≤10 nm

Maximum travel speed: 2 mm/s

Integrated control system

Ion Beam-Electron Beam Collaboration



Gas Injection System

Single GIS design

Various gas precursor sources available

Needle insertion distance: ≥35 mm

Motion repeatability: ≤10 μm

Heating temperature control repeatability: ≤0.1°C

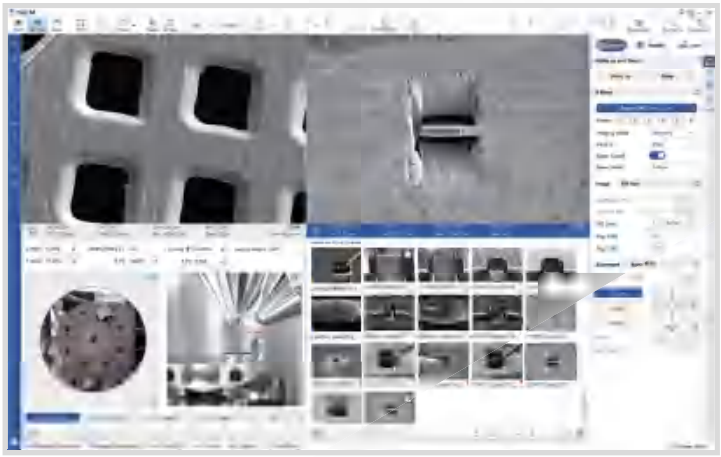
Heating range: room temperature ~ 90°C

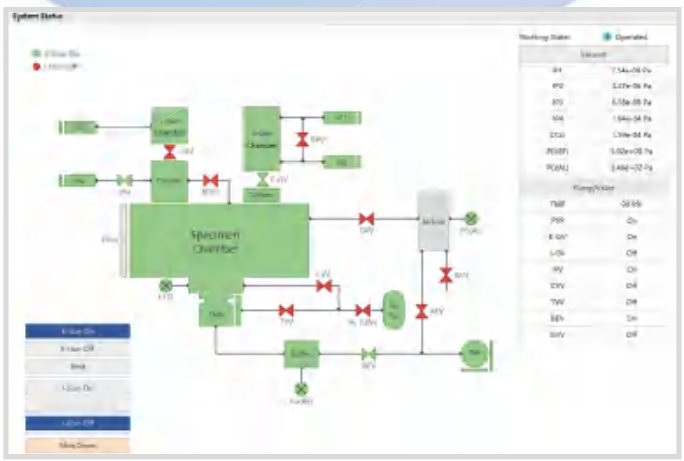
Integrated control system

Graphic User Interface

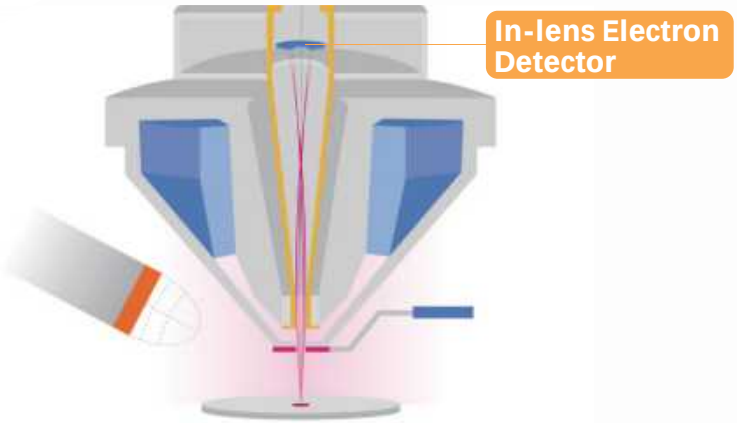
Highly integrated user interface platform together with scanning electron microscope (SEM) Imaging and processing integrated within an overall user interface with comparative references displayed on the left and right

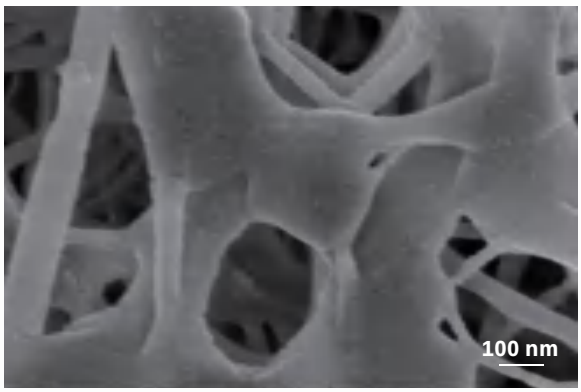
Self-developed accessories hardware and user interface such as gas injection system and nano-manipulator, intuitive design of layout for easy-to-use operation





In-lens electron detector

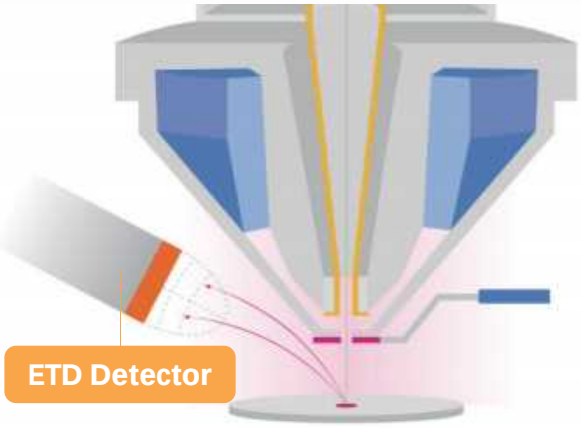




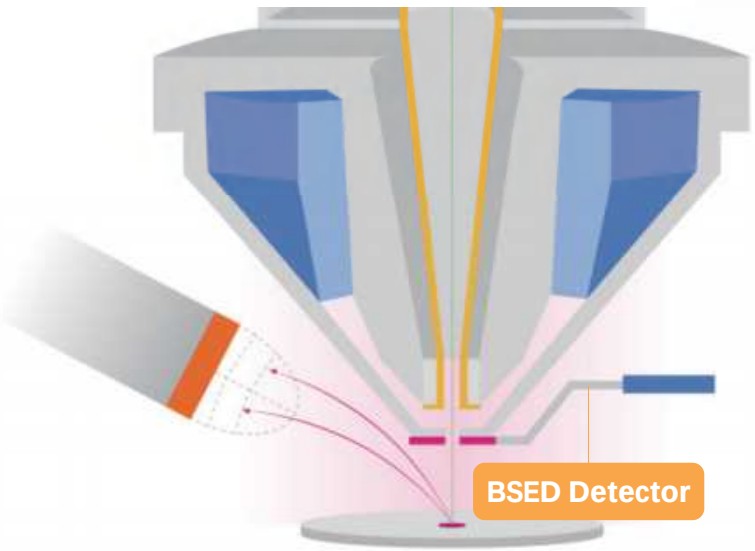
Polymer/2 kV/100,000X/Inlens

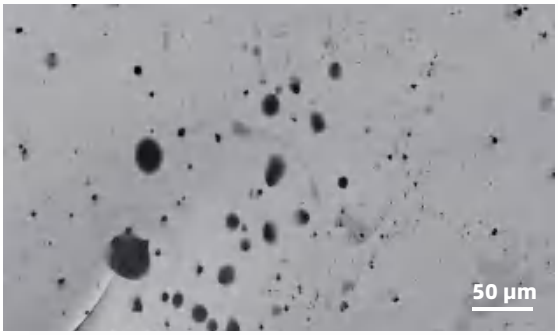
Everhart-Thornley Detector（ETD）

Metallic silver, low-voltage ETD image characterizes its thin film topography

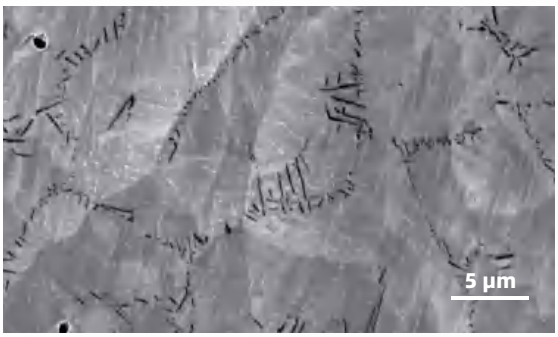


Retractable Back-Scattered Electron Detector（Optional）



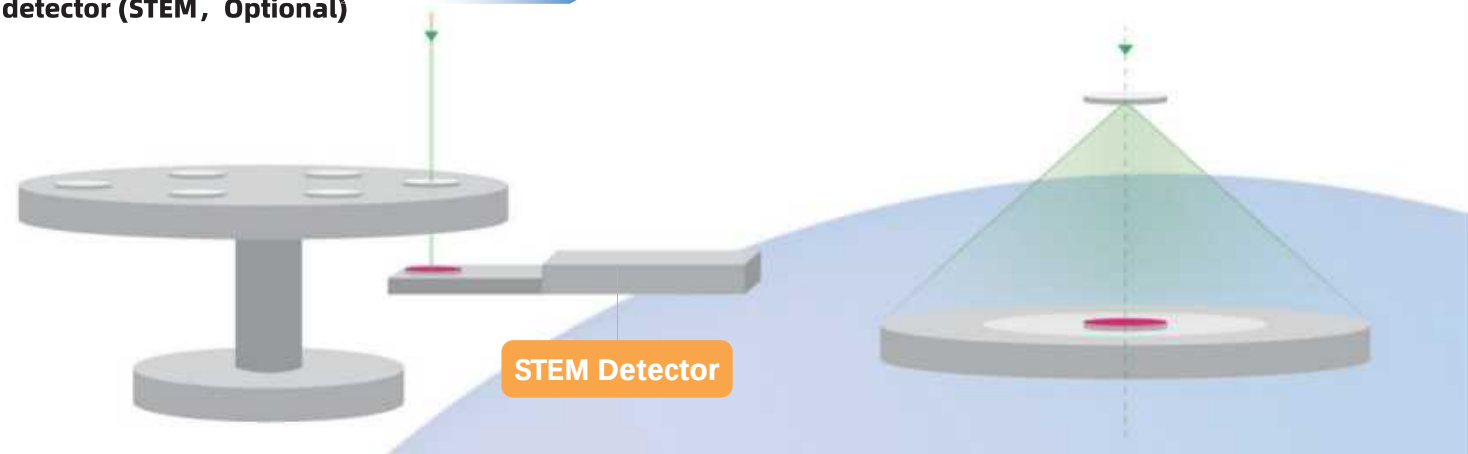


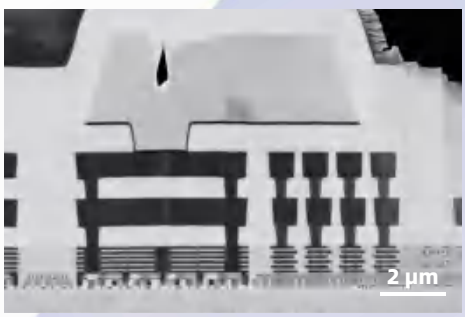
Organic substances on metal surfaces



Reinforcement phases in alloy

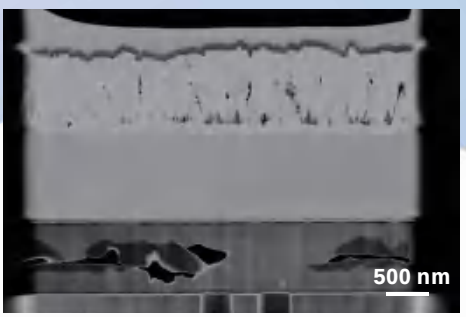
Scanning Transmission Electron Microscopy detector (STEM，Optional)





Advanced process IC chips Bright-field image (STEM-BF)

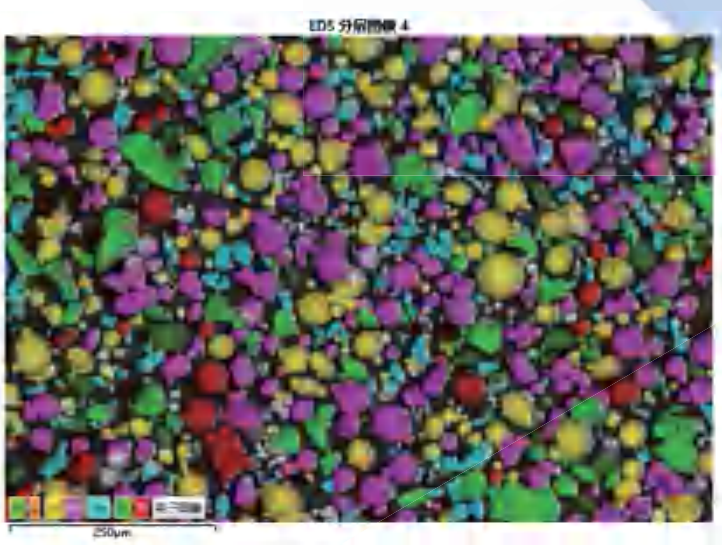
IC Chip device layer Dark-field image (STEM-DF)

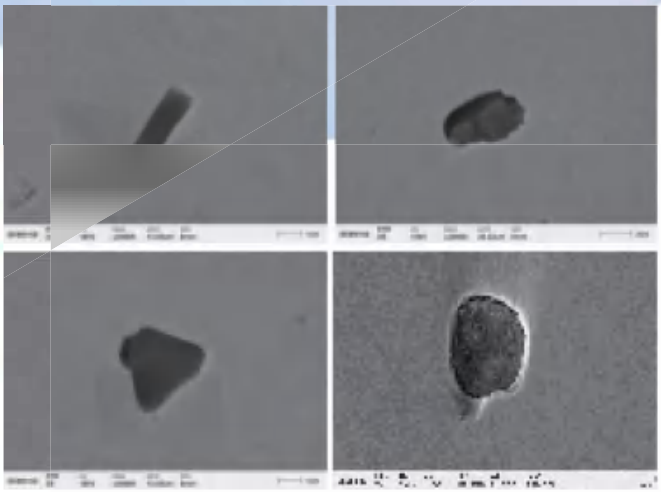


IC Chip aluminum layer Dark-field image (STEM-DF)

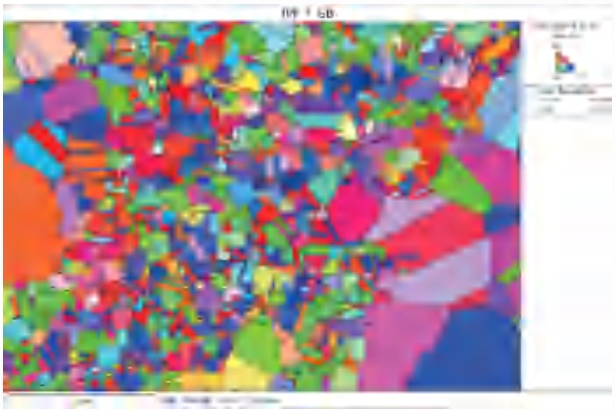
Advances in CIQTEK electron microscopy technology - more options

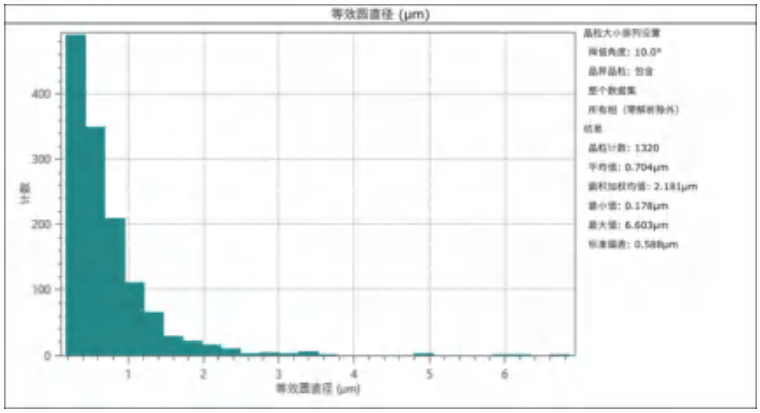
Energy Dispersive Spectrometry



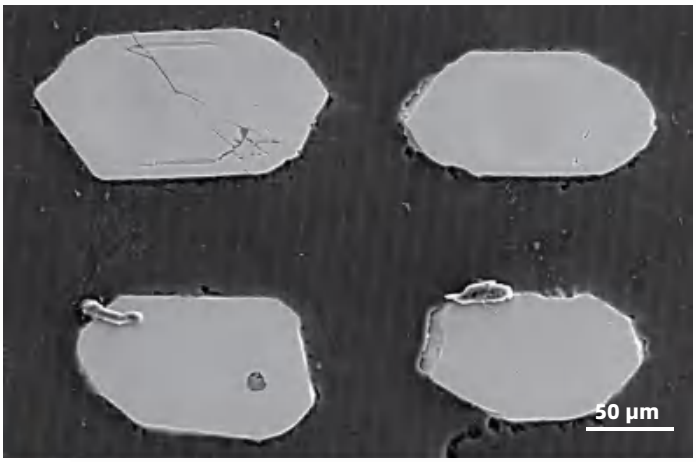


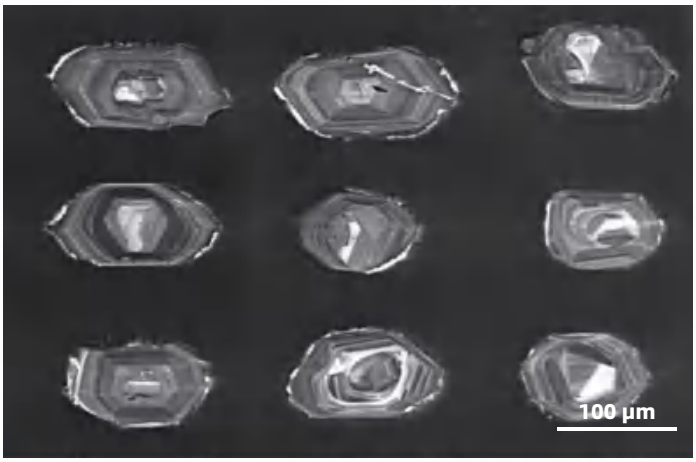
EBSD





Catholuminescence





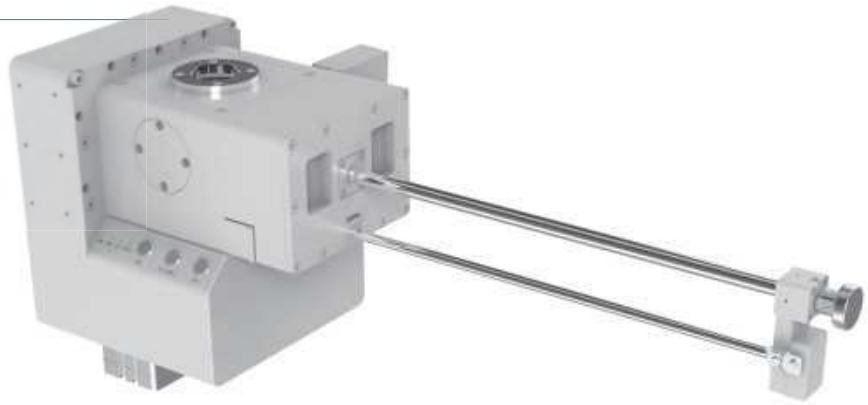
Specimen Exchange Loadlock

Features:

Effectively reduce chamber contamination
Linear guiding rail design, drawer-style opening and closing

4-inches（110 mmx40 mm）

8-inches（208 mmx40 mm）



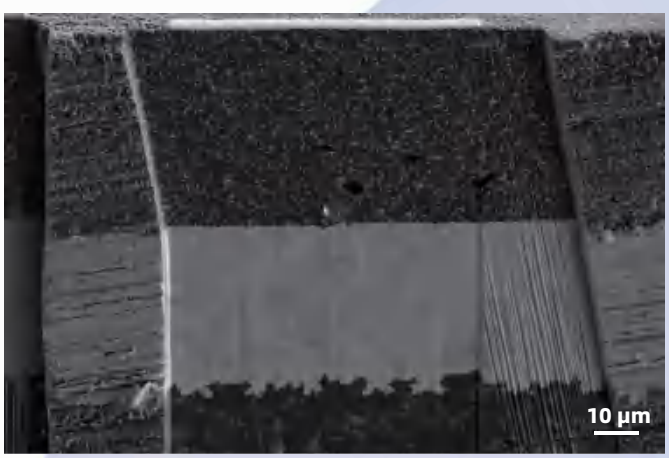
Application

Semiconductor

In the semiconductor industry, IC chips may encounter various failures. To improve reliability, various methods are used to analyze the chips. Among them, Focused Ion Beam (FIB) analysis is a reliable analytical technique.

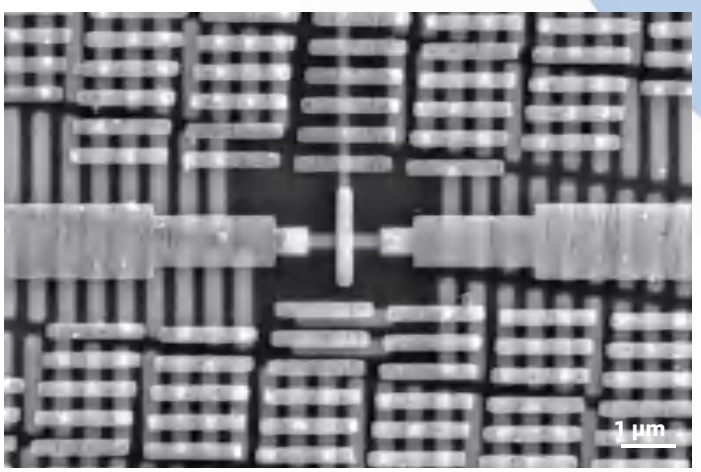
Specimen Characterization/ Micro-Nano Fabrication/ Cross-Sectional Analysis/ TEM Specimen Preparation/ Failure Analysis

Cross-Section Observation

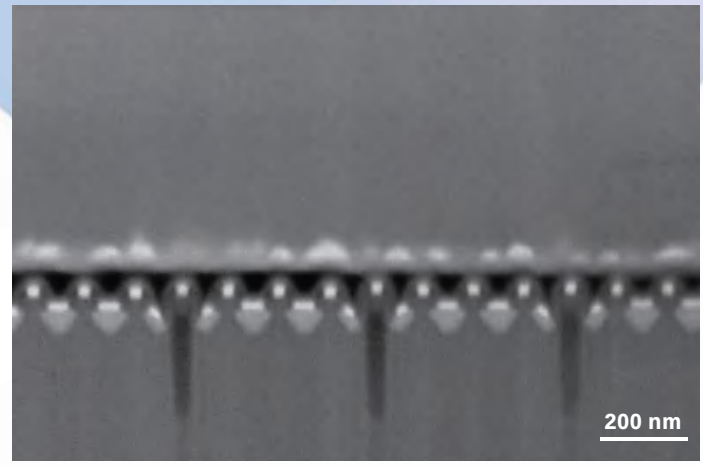


Large-Scale milling on PCB Cross-Section

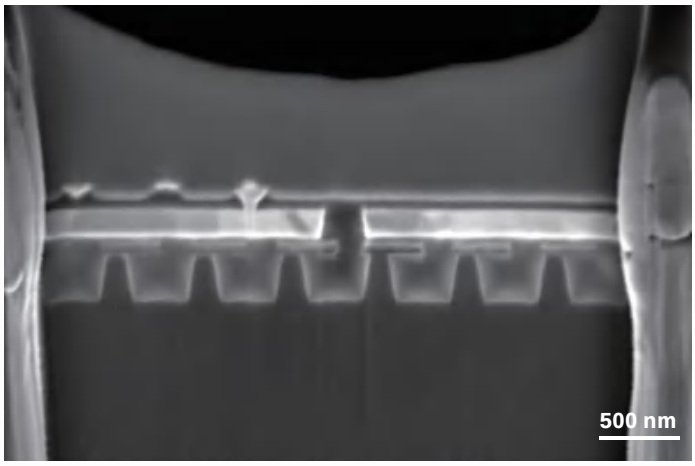
TEM Specimen Preparation



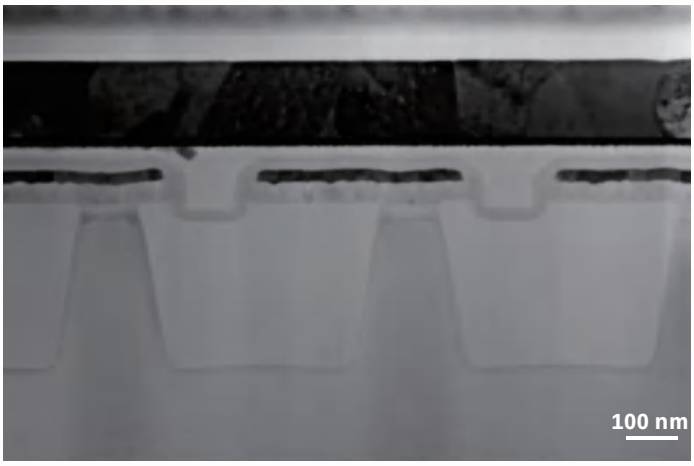
28nm Cu Processed IC Chip Top view



28nm Cu Processed IC Chip/ Cross-Section



28nm Cu Processed IC Chip/ Cross-Section



28nm CuProcessed IC Chip STEM-BF

Al Processed Cross-Section

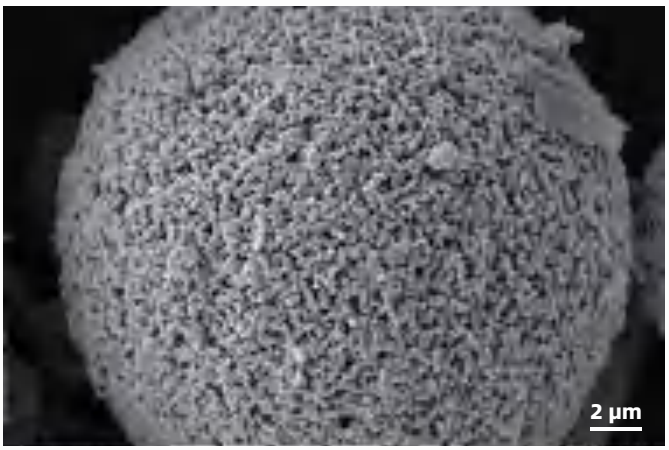
SiC Doping

New Energy Industry

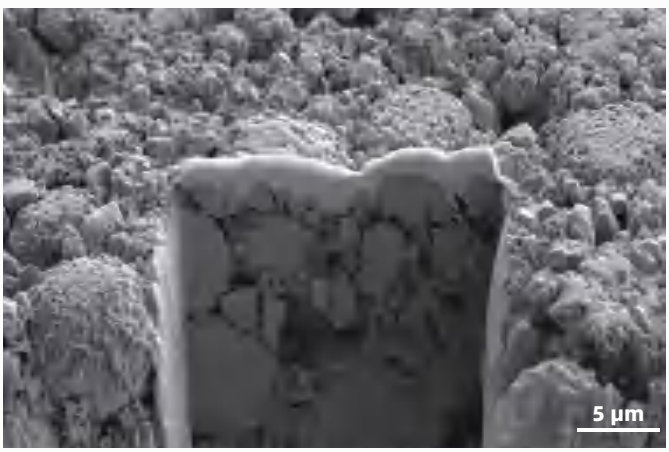
Observation and analysis of material cross-sections for research and process development

Morphologyl observation/particle size analysis/cross-section analysis

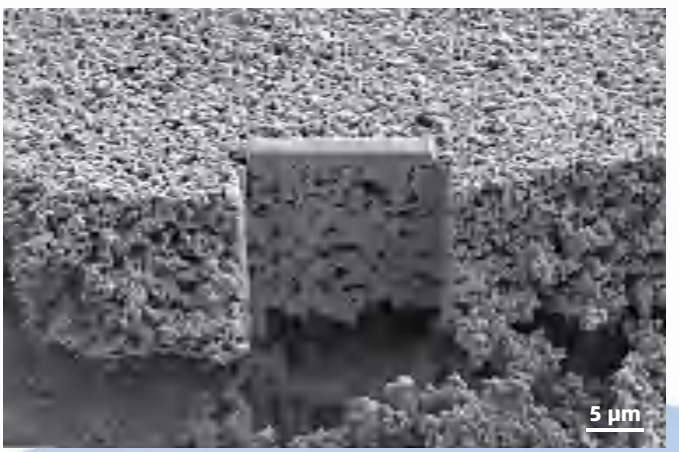
Composition and phase analysis/failure analysis of lithium-ion battery material/TEM sample preparation...



Surface of ternary Li battery materials



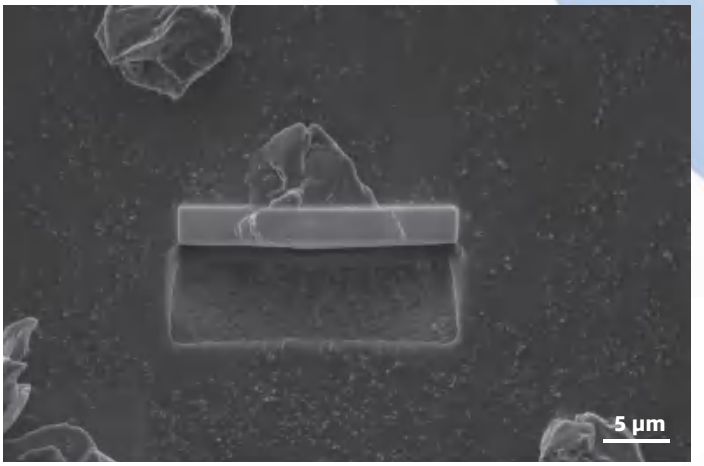
Cross-section of ternary Li battery materials



Cross-section of ternary Li battery materials

Surface processing location of proton exchange membranes

Cross-section of proton exchange membranes

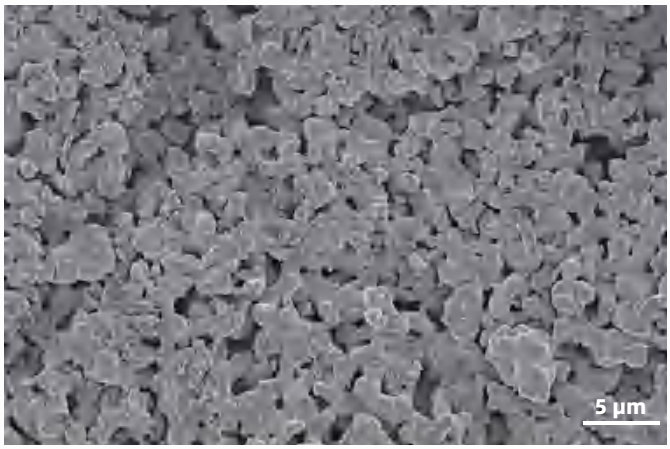


Surface processing location of graphite particles

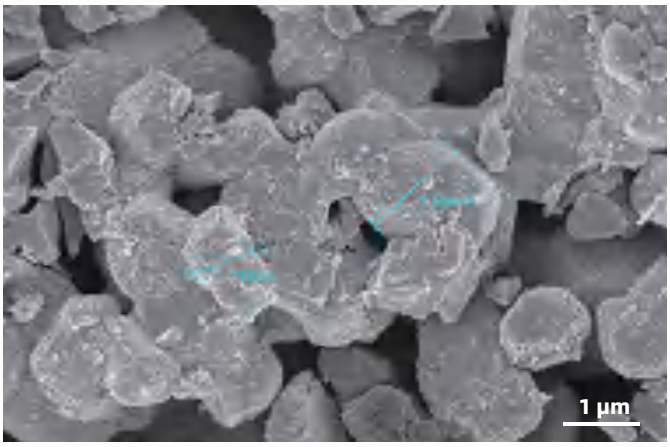
Cross-section of graphite particles

Ceramic material

Material analysis: The FIB-SEM system can perform high-precision micro-nano machining and imaging to ceramic materials, combined with various signal detection modes such as backscattered electrons (BSE), energy-dispersive X-ray spectroscopy (EDX), Electron Backscattered Diffraction Pattern (EBSD), and secondary ion mass spectrometry (SIMS), to study the material in a micro to nano-scale with three-dimensional space in depth.



Surface of ceramic materials



Surface of ceramic materials

Cross-section of Ceramic materials

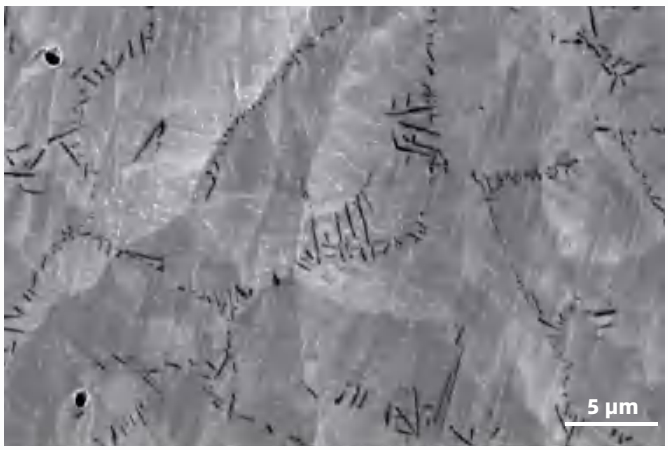
Alloy material

In order to increase the strength, hardness, toughness, etc., of metals, other substances such as ceramics, metals, fibers, etc., are added into the metal using methods such as metallurgy, casting, extrusion, etc., which are called its reinforced phases.

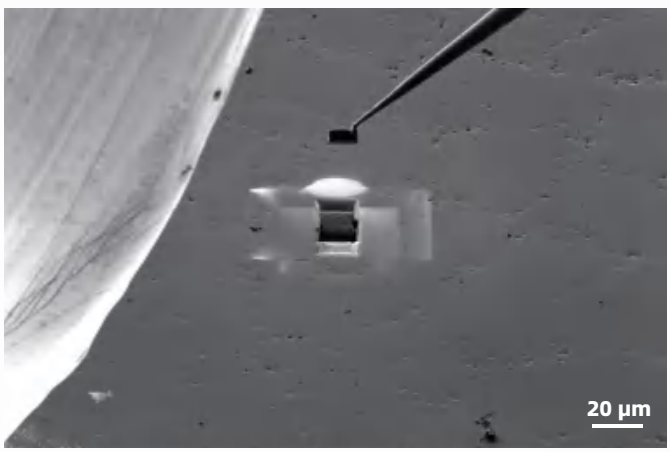
TEM specimen prepared by a FIB-SEM is used to observe information such as reinforced phases and boundary atoms through transmitted electron signals.

TEM specimen can be used for transmission Kikuchi Diffraction (TKD) analysis.

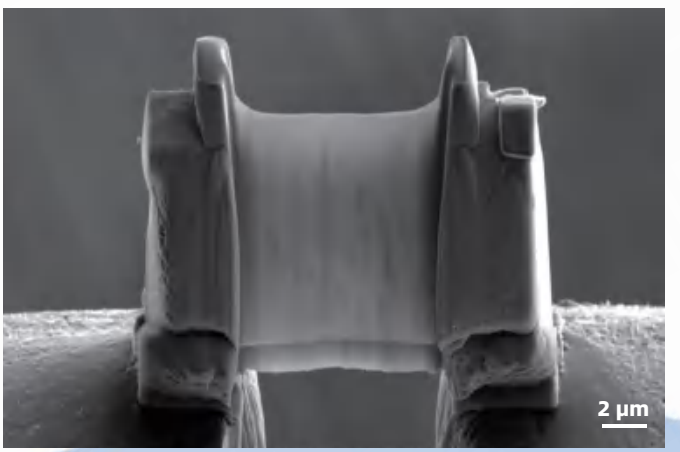
Can be used for metallographic analysis/compositional analysis/in-situ testing of alloy cross-sections



Surface of titanium metal

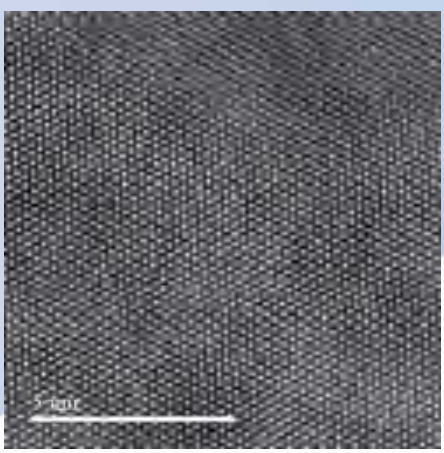


Lamella lift-out by nano-manipulator



Reinforced phases in titanium metal lamella

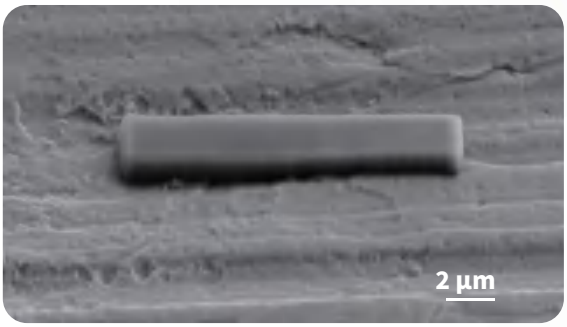
Electron image of Ferrite-martensite steel (magnetic) taken in a DB500 FIB-SEM



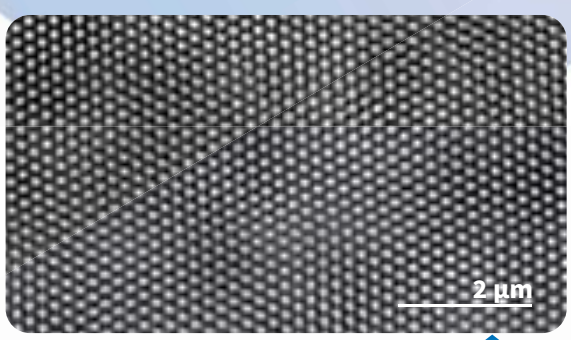
Atomic image of Ferrite-martensite steel (STEM-HAADF)

Machining capability

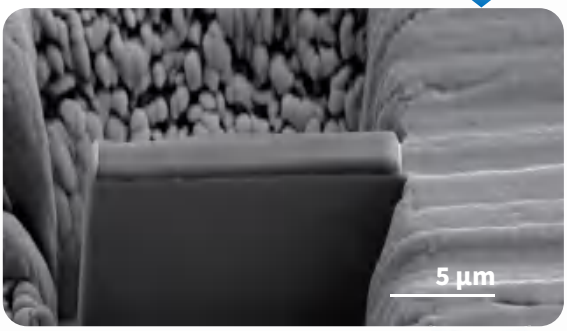
TEM lamella specimen preparation flowchart



① Pt deposition of protective layer

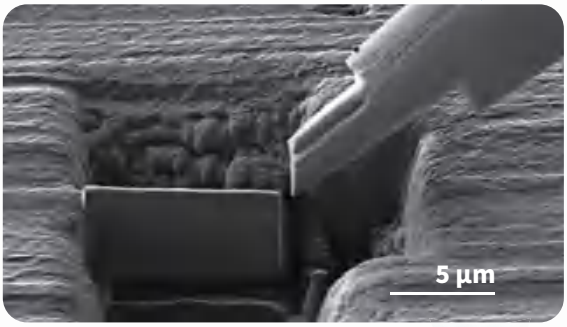


⑧ TEM experimental verification



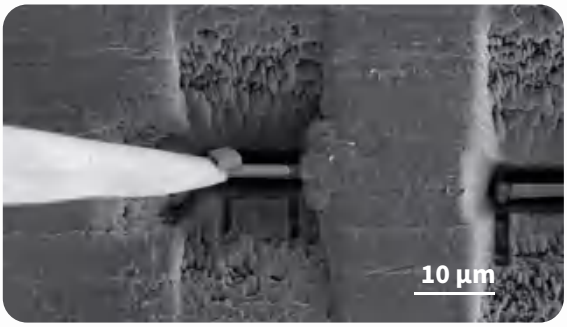
② Rough then precision milling for gross preparation of lamella

⑦ Lamella thinning process

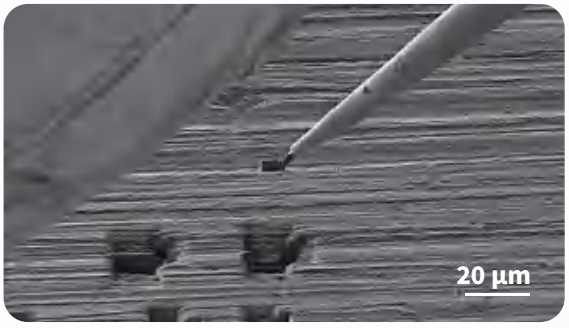


③ Partial separation done on lamella, prior to welding onto a nano-manipulator.

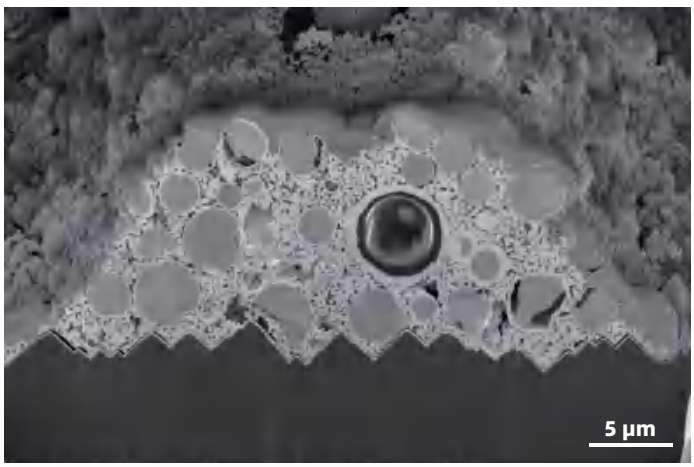
⑥ Weld lamella onto a copper grid



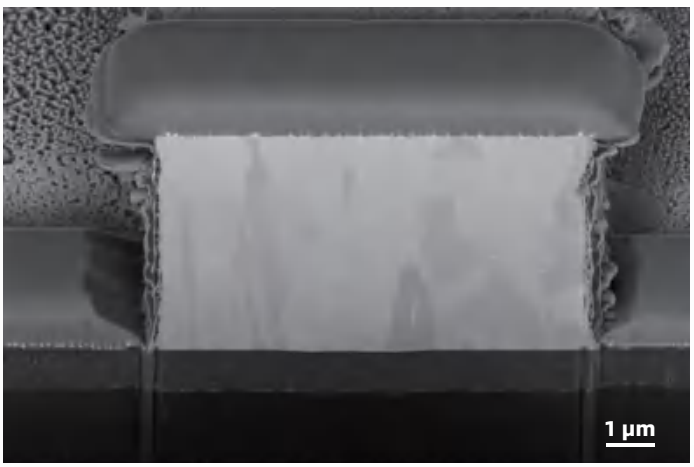
④ Once welded, finish-off of a U-cut prior to lamella lift-out.



⑤ Lift-out done by a nano-manipulator

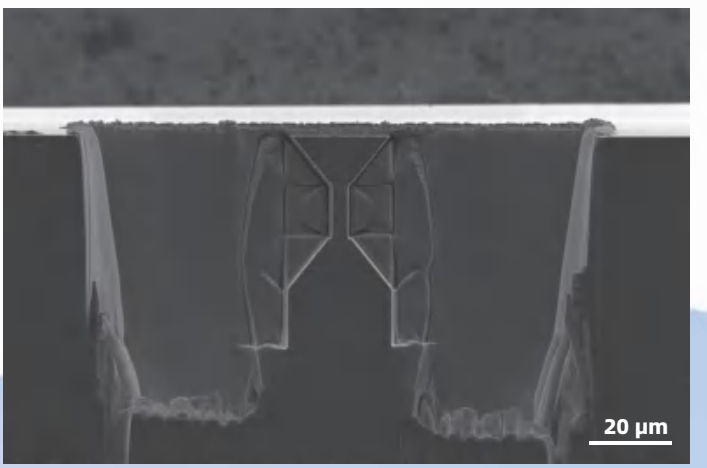


Solar PV Silver Wire Cross-Section



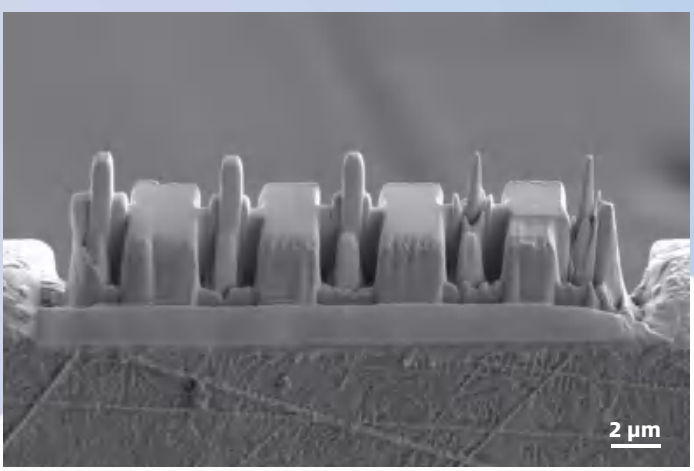
Copper Wire Cross-Section

In-Situ pressure Sample Preparation



In-Situ Tensile Sample Preparation

In-Situ Heating EBSD Sample Preparation



In-Situ Tensile TEM Sample Preparation

Specifications

Electron Optics	Electron gun	High Brightness Schottky Field Emission Electron Gun
	Resolution	0.9 nm@15 kV；1.6 nm@1.0 kV
	Acceleration voltage	20 V ~ 30 kV
Ion Beam System	Ion source	Gallium
	Resolution	3 nm@30 kV
	Acceleration voltage	500 V ~ 30 kV
Specimen Chamber	Vacuum system	Fully Automated, Oil-Free Vacuum System
	Camera	Three cameras （Optical navigation X1 + chamber monitoringx2）
	Stage Type	Motorized 5-axis mechanical eucentric specimen stage
	Stage Travel range	X=110 mm，Y=110 mm，Z=65 mm T: -10°~+70°，R: 360°
Detector&Optional	Standard	In-lens Electron Everhart-Thornley Detector（ETD）
	Optional	Retractable Back-Scattered Electron Detector（BSED） Scanning Transmission Electron Microscopy Detector（STEM） Energy Dispersive Spectrometer（EDS） Electron Backscattered Diffraction Pattern（EBSD ） Nano-manipulator Gas injection Plasma cleaner Specimen exchange loadlock Trackball & Knob Control Panel
User interface	Operation System	Windows
	avigation	Optical navigation, gesture quick navigation
	Automatic Functions	Auto brightness & contrast, auto focus, auto stigmator

Memo No.

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