

Key benefits

- Field emission SEM with ultra-stable, high current Schottky gun
- Advanced optics and detection, including immersion mode, beam deceleration, in-lens TLD-SE and -BSE, DBS and STEM for best selection of the information and image optimization
- Beam landing energy down to 50 V
- 1.4 nm @ 1 kV without beam deceleration
- World's only true high resolution low vacuum FESEM : 1.8 nm @ 3 kV and 30 Pa
- Up to 200 nA for analysis in high or low vacuum
- Integrated 16-bit scanning/patterning engine
- Ultra-clean, oil free scroll- and turbo-pumped vacuum system
- 150 x 150 mm high precision, high stability piezo stage (Nova NanoSEM 650)

Nova™ NanoSEM 50 series

Ultra-high resolution characterization and analysis of the widest range of samples, with extreme ease!

Precise, true nanometer scale information. Superb contrast at high and low kV. Highly resolved sub-100 V imaging. Fast analysis. Ultra-high resolution investigation of the most charging or contaminating specimens using low vacuum. These have already been integral features of the Nova™ NanoSEM field-emission SEM for many years.

With the Nova NanoSEM 50 series, even more becomes possible. In addition to the powerful combination of advanced optics (including a two-mode final lens), SE/BSE (Secondary Electrons/Backscattered Electrons) in-lens detection and beam deceleration, the Nova NanoSEM 50 series introduces a new suite of latest generation, high sensitivity retractable SE/BSE and STEM detectors, as well as versatile SE/BSE filtering capabilities, to best optimize the information of interest. Intelligent scanning modes are available to minimize imaging artefacts. Sample cleanliness, critical for low kV high resolution imaging, is maintained using FEI's integrated solutions for keeping the sample surface free from hydrocarbon contamination. There are improvements for analysis too, with up to 200 nA of beam current and a large motorized tilt stage on the Nova NanoSEM 450. And all this without compromising the Nova NanoSEM's high resolution performance.

More samples, including the most non-conducting or contaminating materials, can equally be characterized or analyzed in the Nova NanoSEM 50 series, using its unique low vacuum capabilities. Characterization in low vacuum extends all the way up to ultra-high resolution, thanks to FEI's Helix™ detector technology. Small and large samples can easily be accommodated inside the large chamber, on the Nova NanoSEM's high precision, high stability stages. In addition, a high definition camera and a correlative navigation unit help to find and move to the right region of interest in no time.

For nanoprototyping, the Nova NanoSEM 50 series offers the most extensive set of integrated tools, including a 16-bit on-board digital pattern generator and dedicated patterning software, a high speed electrostatic beam blaster and gas injection systems for direct electron beam writing of nanostructures. The Nova NanoSEM 650's stage is empowered by piezo-motors for producing finer, higher XY repeatability over the full 150 x 150 mm range of movement.

Spectacular results are consistently obtained on a variety of challenging materials, in particular nanoparticles and powders, nanotubes and nanowires, plastic electronics, glass substrates, organic materials, diamond films and more. Easy to use, extremely versatile with respect to the sample or information sought, the Nova NanoSEM 50 series is the perfect solution for the most demanding characterization and analysis needs at the nanoscale.

Essential specifications

Electron optics

- High resolution field emission-SEM column, with:
 - 2-mode (field-free and immersion) final lens
 - 60 degree objective lens geometry
 - Heated objective apertures
 - Through-the-lens differential pumping
 - Beam deceleration with stage bias from +50 V to -4000 V
 - High stability Schottky field emission gun
- Source lifetime, 12 months guaranteed

Electron beam resolution

- High vacuum imaging, optimum WD
 - 0.8 nm at 30 kV (STEM)
 - 1.0 nm at 15 kV (TLD-SE)
 - 1.4 nm at 1 kV (TLD-SE) without beam deceleration
 - 3.5 nm at 100 V (DBS)
- High vacuum analysis, analytical WD
 - 3.0 nm at 15 kV and 5 nA (TLD-SE)
- Low vacuum imaging, optimum WD
 - 1.5 nm at 10 kV (Helix detector)
 - 1.8 nm at 3 kV (Helix detector)

Electron beam parameter space

- Beam landing energy: 50 eV - 30 keV
- Probe current: 0.6 pA - 200 nA continuously adjustable
- Max. horizontal field width: 4.0 mm at 5 mm WD (corresponds to 35 x minimum magnification in quad view)

Chamber

- Left to right: 379 mm
- Analytical working distance: 5 mm
- Ports: 21
- EDS take-off angle: 35°

Detectors

- In-lens SE detector (TLD-SE)
- In-lens BSE detector (TLD-BSE)
- Everhardt-Thornley SED
- Low vacuum SED (LVD)
- IR-CCD
- High sensitivity low kV Directional Backscattered Detector (DBS), lens-mount* or retractable*
- Retractable STEM BF DF HAADF detector*
- TV-rate low vacuum solid-state BSED (GAD)*
- UHR low vacuum SED (Helix detector)*

Vacuum system

- Complete oil free vacuum system
- 1 x 220 l/s TMP
- 1 x PVP-scroll
- 2 x IGP
- Chamber vacuum (high vacuum) < 6 x 10⁻⁶ mbar (after 24 hours pumping)
- Chamber vacuum (low vacuum) < 2 mBar
- Evacuation time: < 3.5 minute

Sample holders

- Multi-stub holder, mounts directly onto the stage, hosts up to 5 standard stubs (Ø12 mm)
- Vise Specimen Holder*, to clamp irregular, large or heavy specimens to the stage
- Cross-Sectional Holder for non-loadlock systems
- Universal Mounting Base (UMB)* for stable, flexible mounting of many combinations of samples and holders such as flat and pre-tilt stubs, and row holders for TEM grids
- Various wafer and custom holders*, available on request

* optional

Table 1: Stage and sample

Nova NanoSEM	450	650
Type	Eucentric goniometer stage, 5-axes motorized	
XY	110 x 110 mm	150 x 150 mm piezo Optional Stage Mapping
Repeatability	< 2.0 µm (@0° tilt)	< 1.0 µm (@0° tilt)
Z	25 mm	10 mm
Rotation	n x 360°	n x 360° piezo
Tilt	-15° / +75°	-10° / +60°
Max. sample height	Clearance 60 mm to eucentric point	Clearance 55 mm to eucentric point
Max. sample weight	500 g in any stage position (up to 2 kg at 0°tilt)	500 g
Max. sample size	Ø150 mm with full rotation (larger samples possible with limited rotation)	

Image processor

- Dwell time range from 0.050 to 25,000 $\mu\text{s}/\text{pixel}$
- Up to 4096 x 3536 pixels
- File type: TIFF (8, 16, 24-bit), BMP or JPEG, standard
- Single-frame or 4-quad image display
- Smartscan™ (256-frame average or integration, line integration and averaging, interlaced scanning), DCFI (Drift Compensated Frame Integration)

System control

- 32-bit GUI with *Windows XP*®, keyboard, optical mouse
- “Beams per quad” graphical user interface concept, with up to 4 simultaneously active quads
- 19-inch LCD display, SVGA 1280 x 1024 (second monitor optional)
- MagicSwitch (software-controlled switchbox)
- Joystick*
- Multifunctional control panel*

Accessories

- Sample / chamber cleaning: FEI CryoCleaner, FEI integrated plasma cleaner
- Analysis: EDS, EBSD, WDS, CL
- QuickLoader™: loadlock for fast sample transfer
- Navigation: Nav Cam™, Correlative Navigation, CAD Navigation
- FEI Gas Injection: up to 2 units (other accessories may limit number of GIS available) for beam-induced deposition of the following materials:
 - Platinum
 - Tungsten
 - Carbon
- Prototyping: Integrated 16-bit patterning engine, Fast Beam Blanker, Electron Beam Lithography modules
- Cryostage
- Manipulators
- Electrical probing

Warranty and training

- 1 year warranty
- Choice of service maintenance contracts
- Choice of operation / application training contracts

Documentation

- Operating instructions handbook
- On-line help
- Prepared for RAPID™ (Remote Diagnostic Support)
- Free access to ‘FEI for Owners’ on-line resources



Nova NanoSEM 450 with optional Nav Cam and Plasma Cleaner



Nova NanoSEM 650 with optional Nav Cam, QuickLoader and second monitor

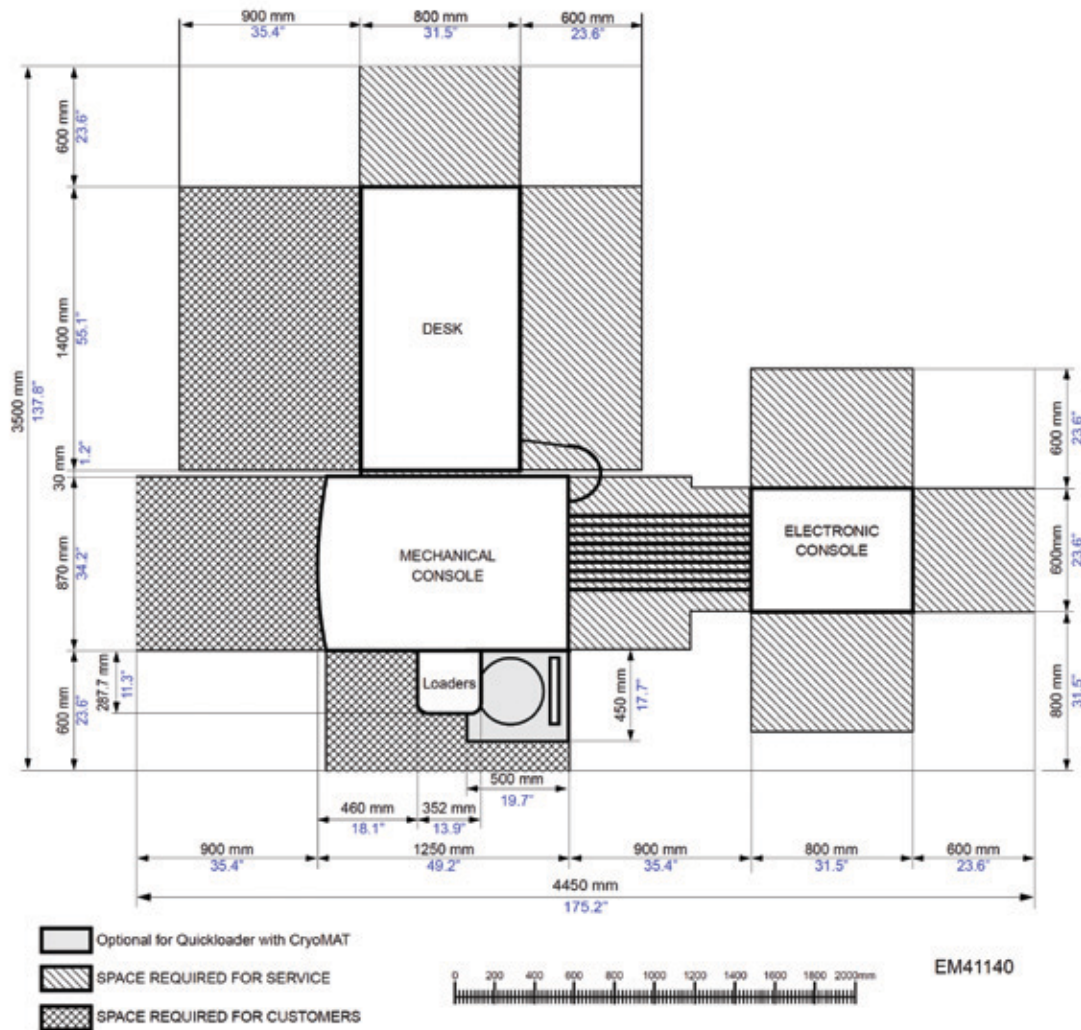
Installation requirements

[Refer to pre install guide for detailed data]

- Power
 - Voltage 230 V (-6%, +10%),
 - Frequency 50 or 60 Hz (± 1%)
 - Consumption: < 3.0 kVA for basic microscope
- Environment
 - Temperature 20°C ± 3°C
 - Relative humidity below 80% RH,
 - Stray AC magnetic fields < 100 nT a-synchronous, < 300 nT synchronous
- Door width: 120 cm
- Weight: basic system 750 kg
- Compressed air 4-6 bar - clean, dry and oil-free
- System chiller
- Acoustics: < 60 dBC standard utilities

Typical floorplan

[Other floorplans available upon request]



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