NW-EM NANOWORKSTATION

Manipulation & characterization system for SEM & FIB



NW-EM NanoWorkstation

The current challenge in the field of microscopy is to add the "hand" function to the electron microscope to allow physical manipulation and characterization at the micro- and nanoscale.

The NanoWorkstation is a powerful, dedicated system that performs such tasks with ease and can be integrated into most commercially available SEMs and FIBs.

The NanoWorkstation makes high-end manipulation practical and affordable for industrial and research labs, allowing you to remain competitive in



More compact and more flexible	Clearer and simpler
Small and practical	Intuitive control interfaces and software
Plug-and-play system with modular components	User-friendly and easy to learn
Interfacing solutions for most SEM's & FIB's	Quick and easy tool exchange
Fast setup and removal	Compact, stand-alone electronics
Pioneering cabling technology	Effortless work with multiple manipulators

More robust and more stable	Faste
Excellent stability	High
Low drift (1 nm/min)	Sub-i
Reliable operation (one year endurance test)	No b
Virtually insusceptible to vibrations	Exter
Fast pre-positioning by hand	Coars

a world where critical dimensions are now in the nanometer range.

The module-based system offers high versatility, giving you the flexibility to perform numerous different specialized applications by simply changing the tool attached to the front of the manipulator, whether it is moving, assembling, preparing, rotating, pushing, probing, feeling, listening, gripping or any other task you can imagine.

'Give your microscope a hand'.

er and more precise

- n operating velocity (up to 10 mm/sec)
- nanometer resolution (0.25 nm)
- backlash or reversal play
- ensive working range (100 cm³)
- rse and fine displacement in one drive

APPLICATIONS

Nanomanipulation In-situ lift-out Electrical characterization Nanoindentation Tensile measurement Nanoforging



Two bunches of nanotubes lying on a carpet of nanotubes





Selection and transportation of the desired bundle to a target location







Electrical characterization of 130 nm SRAM technology



Manipulation of a carbon nanotube (200 nm \emptyset) using two grippers



TEM sample preparation: in-situ lift-out using a gripper







The foot of the beetle Gastrophysa viridula showing hundreds of adhesive hairs (setae)







The *seta* is attached to the force sensor and load is applied by incrementally moving away until the maximum load is reached and the *seta* breaks



Attachment of an insect leg (seta) to the force sensor

Electrical and mechanical characterization of a single nanotube



The perfect combination

Set up the system using the plug-in tools in any combination you desire. Do some nanoforging and follow it up by using microgrippers to assemble your forged nanoparts. Mount four tungsten tips and you're ready to perform electrical measurements. The applications are only limited by your imagination – the versatility of the system will allow everyone in your lab to benefit.



- 2 Rotational tips
- 4 Microgrippers
- Force measurement system
- iProbe software
- SEM/FIB interfacing
- 50 PT-50 probe needles

PT-50 Probe needles

- Tungsten needles with 50 nm tip radius
- Packaged in protective atmosphere

Microgripper

i

ii

iv

- High-resolution gripper for transport and assembly of micro-sized objects
- Gripping area (5 to 10 μm)²
- Resolution 20 nm
- Gripping force 5 to 5000 µN (variable)
- Maximum span range 20 to 40 μm

iii Rotational tip

- Fourth degree of freedom for the MM3A-EM
- Travel 360° unlimited
- Speed up to 6 rad/s
- Resolution 0.1°
- Torque 0.01 mNm

Force measurement system

- Force and resonance feedback using piezo-resistive sensor technology
- Tip radius < 20 nm</p>

FMT-400 sensor

- Tip force constant (calculation) 2 to 4 N/m
- Maximum tip force 80 μ N $^{\prime}$
- Resistance 500 to 650 Ω
- Sensitivity 3.1×10^{-3} mV/nm at V_{bridge} = 2.5 V ²

FMT-120 sensor

- Tip force constant (calculation) 30 to 40 N/m
- Maximum tip force 360 μN⁻¹
- Resistance 500 to 650 Ω
- Sensitivity 18.8 \times 10⁻³ mV/nm at V_{bridge} = 2.5 V⁻²

¹ Calculated with assumptive deflection of 10% and the lowest force constant ² Dependent on the bias voltage (V_{bridge}) that is applied to the series resistance of sensor and reference





iProbe software

- Dynamic, two-handed, three-dimensional control for four probers
- Precision through six orders of magnitude
- Runs on microscope PC
- iPad version now available



SEM/FIB Interfacing

- Flexible mounting solutions for most SEM/FIB instruments (including load lock)
- Fast setup and removal

MM₃A-EM Micromanipulator

- The industry standard three-axis manipulator with unmatched stability and precision
- Dimensions 60 × 22 × 25 mm
- Operating range AB 240°
 Operating range C 12 mm
- Piezo range A 4 × 10⁻⁴ rad (20 μm)
 Piezo range B 4 × 10⁻⁴ rad (15 μm)
 Piezo range C 1 μm
- Speed AB up to 10 mm/s
 Speed C up to 2 mm/s
- Resolution A 10⁻⁷ rad (5 nm) Resolution B 10⁻⁷ rad (3.5 nm) Resolution C 0.25 nm

Contact us at info@kleindiek.com or find your local agent at www.kleindiek.com



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