NW-EM NANOWORKSTATION

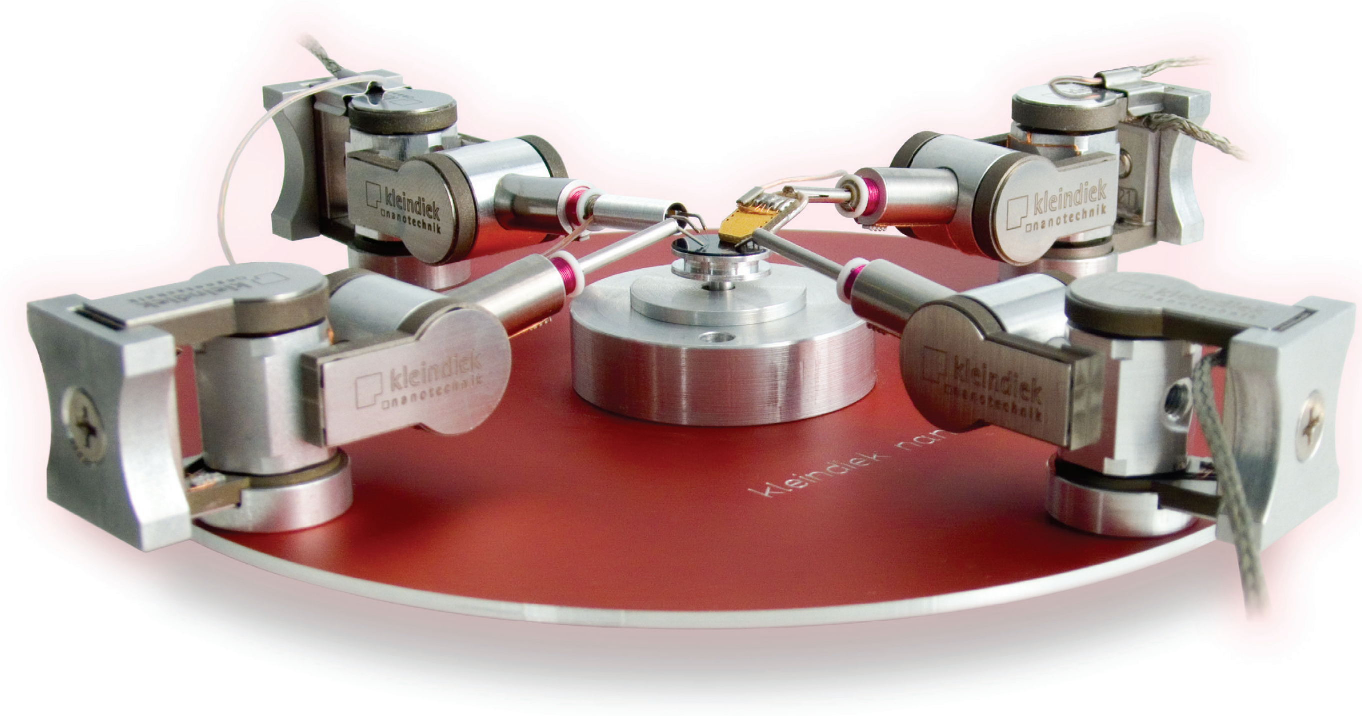
Manipulation & characterization system for SEM & FIB

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 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!'

More compact and more flexible

- Small and practical
- Plug-and-play system with modular components
- Interfacing solutions for most SEM's & FIB's
- Fast setup and removal
- Pioneering cabling technology

Clearer and simpler

- Intuitive control interfaces and software
- User-friendly and easy to learn
- Quick and easy tool exchange
- Compact, stand-alone electronics
- Effortless work with multiple manipulators

More robust and more stable

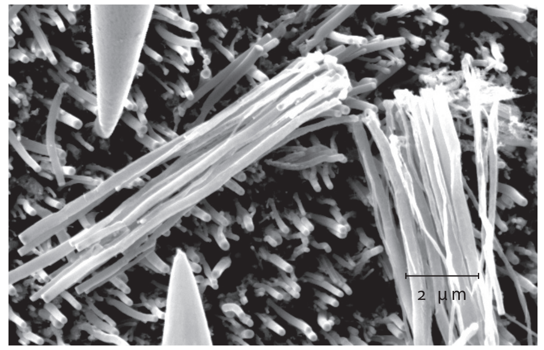
- Excellent stability
- Low drift (1 nm/min)
- Reliable operation (one year endurance test)
- Virtually insusceptible to vibrations
- Fast pre-positioning by hand

Faster and more precise

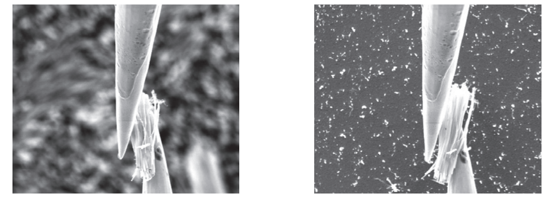
- High operating velocity (up to 10 mm/sec)
- Sub-nanometer resolution (0.25 nm)
- No backlash or reversal play
- Extensive working range (100 cm^3)
- Coarse and fine displacement in one drive

APPLICATIONS

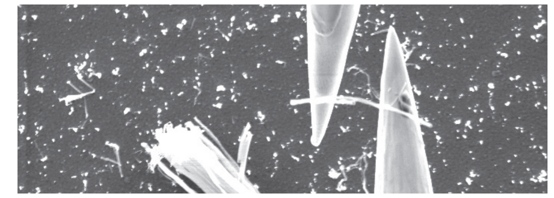
- Nanomanipulation
- In-situ lift-out
- Electrical characterization
- Nanoindentation
- Tensile measurement
- Nanoforging
- STEM



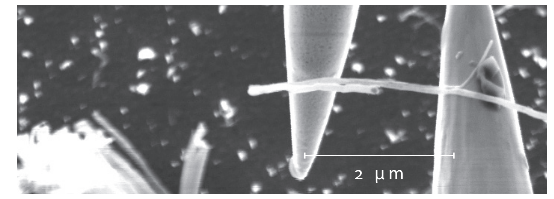
Two bunches of nanotubes lying on a carpet of nanotubes

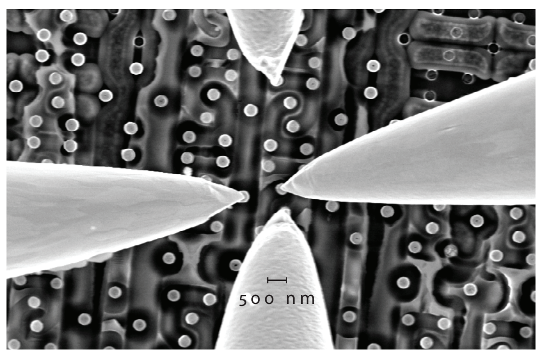


Selection and transportation of the desired bundle to a target location

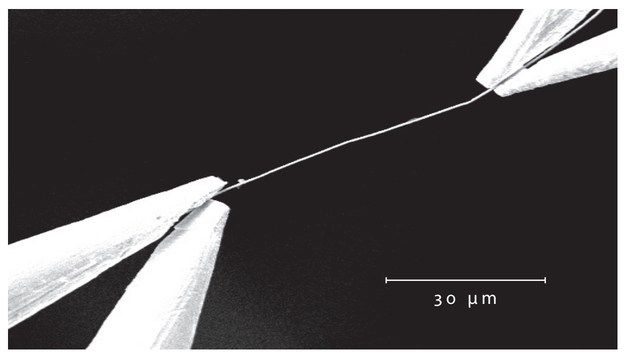


Electrical and mechanical characterization of a single nanotube

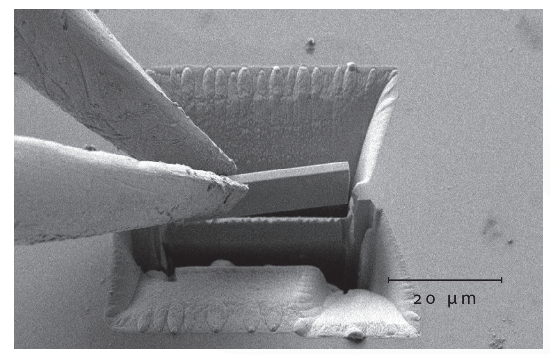




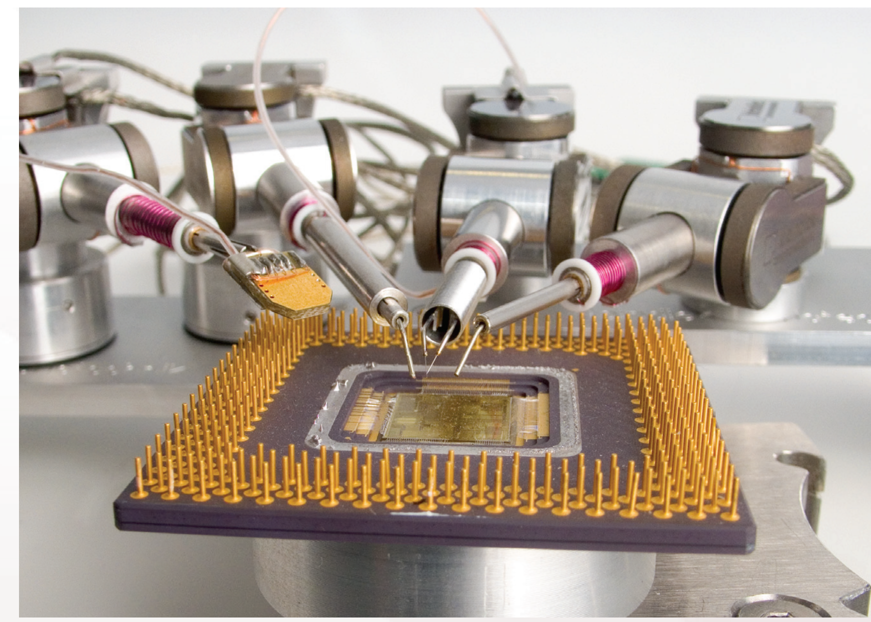
Electrical characterization of 130 nm SRAM technology

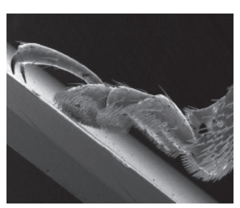


Manipulation of a carbon nanotube (200 nm Ø) using two grippers

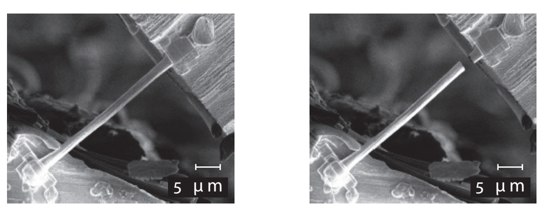


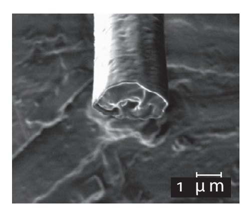
TEM sample preparation: in-situ lift-out using a gripper



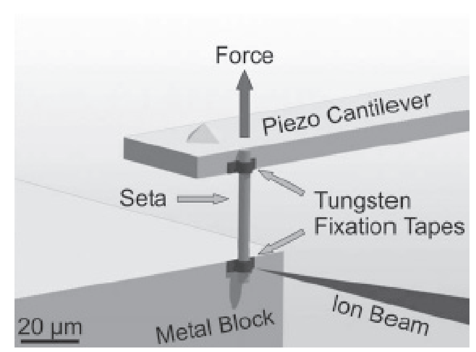


The foot of the beetle *Gastrophysa viridula* showing hundreds of adhesive hairs (*setae*)





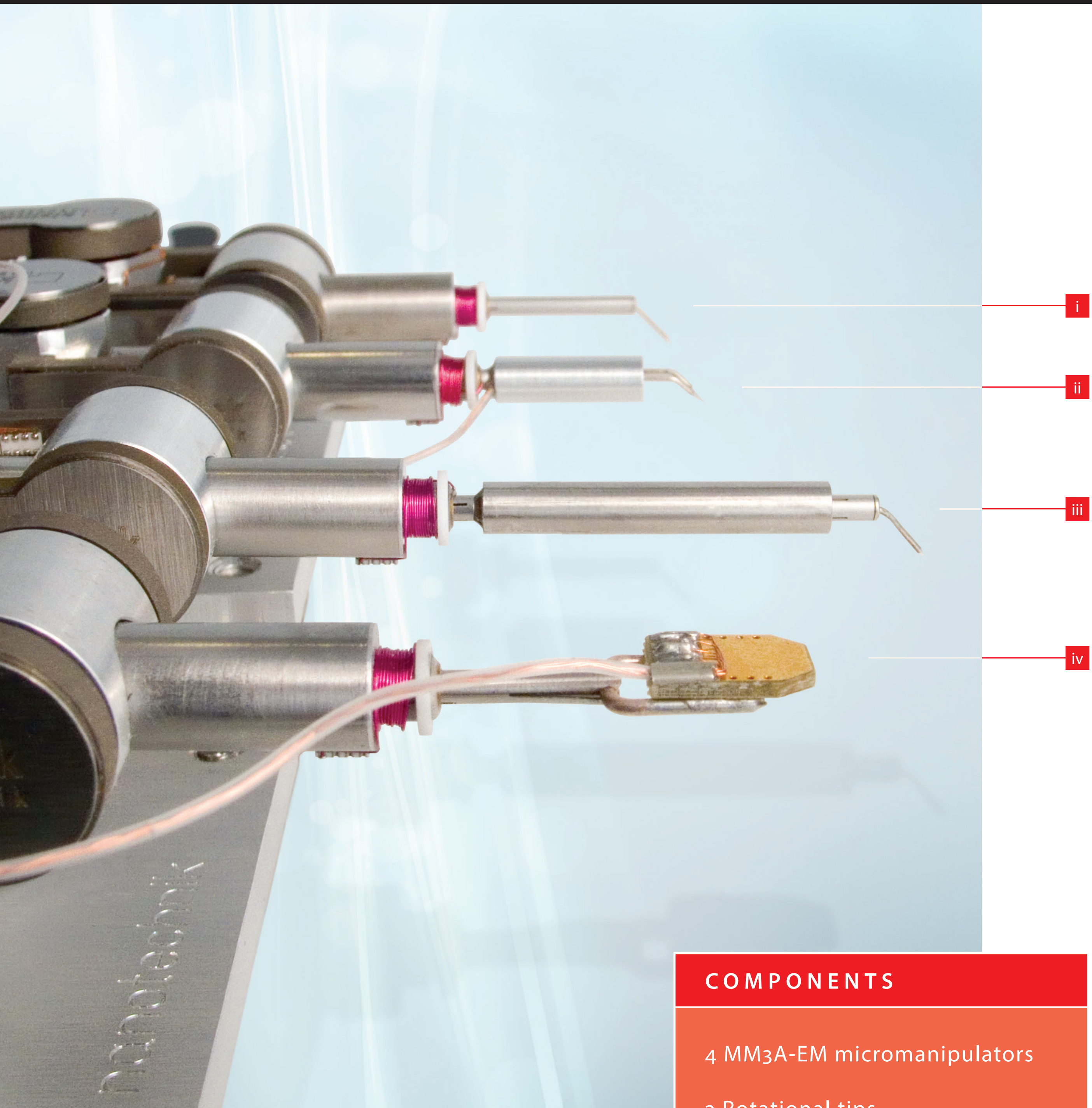
The *seta* is attached to the force sensor and load is applied by incrementally moving away until the maximum load is reached and the *seta* breaks



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

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.



COMPONENTS

4 MM3A-EM micromanipulators

2 Rotational tips

4 Microgrippers

Force measurement system

iProbe software

SEM/FIB interfacing

50 PT-50 probe needles

i PT-50 Probe needles

- Tungsten needles with 50 nm tip radius
- Packaged in protective atmosphere
- Various other tip radii available

ii Microgripper

- High-resolution gripper for transport and assembly of micro-sized objects
- Gripping area (5 to 10 µm)²
- Resolution < 1.5 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

iv Force measurement system

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

FMT-120 sensor

- Tip force constant (calculation) 30 to 40 N/m
- Maximum tip force 360 µN [1]
- Resistance 500 to 650 Ω
- Sensitivity 18.8×10^{-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 7×10^{-9} rad (< 0.5 nm)
  Resolution B 7×10^{-9} rad (< 0.25 nm)
  Resolution C < 0.02 nm

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