LifeForce Nanomanipulation System: LF-2000

Toronto Nano Instrumentation

About

TNI LF-2000 is the most automated SEM-based nanomanipulation system on the market. It is the only system that provides repeatable, drift free, closed-loop nano positioning inside SEM.

Features

- Optimized to probe sub-10 nm process node devices.
- Best positioning performance on market: long range; sub-nanometer resolution.
- Position sensors integrated for automated and programmable movements.
- Optimized design for SEM vacuum environment; fast set-up and removal.

Specifications

System Overview	overall system dimension	127 X 127 X 30 mm
	number of manipulators	1 – 4 manipulators
Manipulator (Coarse)	driving principle	stick-slip
	motion range	10 mm in XY, 4.5 mm in Z
	maximum speed	>2 mm/sec
	minimum step size	<100 nm
Manipulator (Fine)	driving principle	frictionless flexure
	motion range	20 µm in XYZ
	maximum speed	>45 µm/sec
	opened-loop resolution	0.5 nm
	closed-loop resolution	1 nm
	accuracy	better than 5 nm
	drift	<0.35 nm/minute
Software Features:	click-and-move	move from A to B by mouse clicking on computer screen
	link-to-magnification	positioner movement speed automatically adjusted according to SEM magnification
	manipulator position save/load	user defined “save/load” manipulator coordinates
	3D virtual display	real-time three dimensional display of manipulator position and movement
	auto calibration	automated manipulator sensor calibration
	auto alignment of motion axes	all manipulator motion axes auto aligned to SEM image axes

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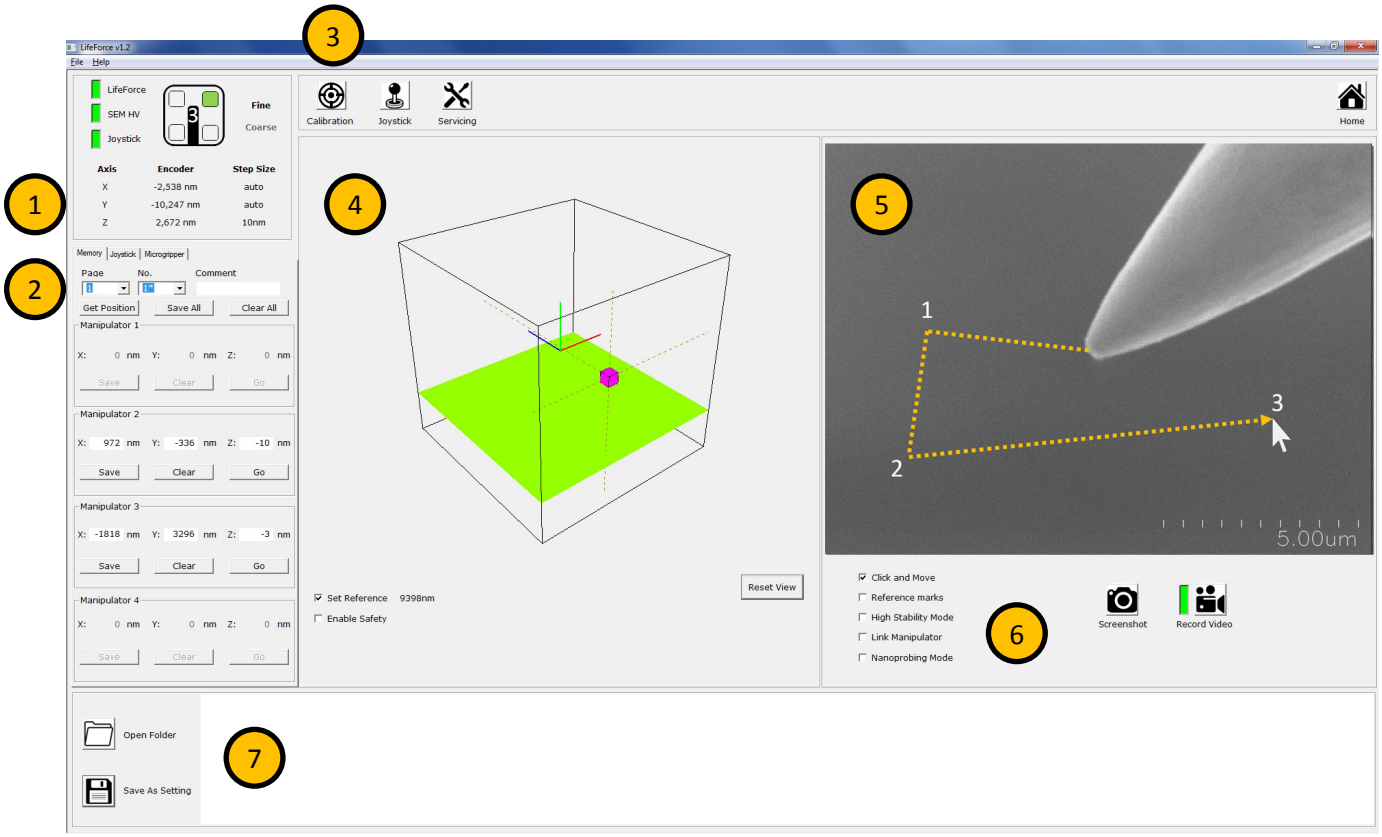
Key Software Functions



1. **Position Feedback:** Provide precise XYZ position feedbacks of each manipulator, with 1 nm resolution.

2. **Save/Load Coordinates:** Save and Load multiple manipulator coordinates.

3. **Auto-Calibration:** Maximizes positioning performance, and align manipulator motion axes to SEM image axes.

4. **3D Virtual Display:** Real-time 3D virtual space showing the manipulator (pink square) and sample (green plane) locations.

5. **Click-and-Move:** On-screen mouse clicking to control manipulator movements.

6. **Link-Manipulators:** Link the motions of multiple manipulators with nanometer precision.

7. **Picture-Video Recording:** Save pictures and videos of the manipulation process in high definitions.

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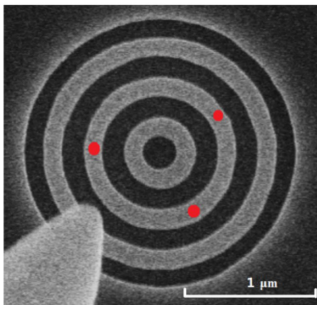
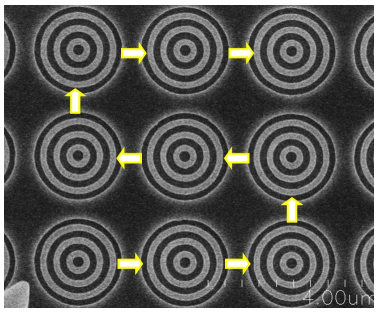
Example Capabilities



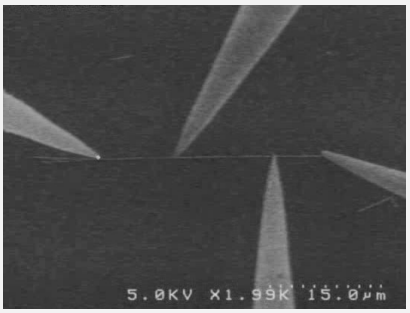


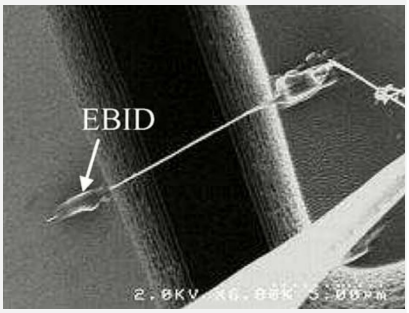
Nanoelectronics Probing

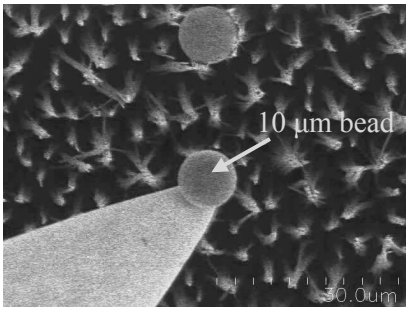
LifeForce is the only commercially available system that allows automated probing of electronic structures, ranging from sub-micrometers, sub-100 nm, and sub-10nm. Positioning probes onto target locations is via computer mouse clicking. Extremely low drift warrants reliable data collection.

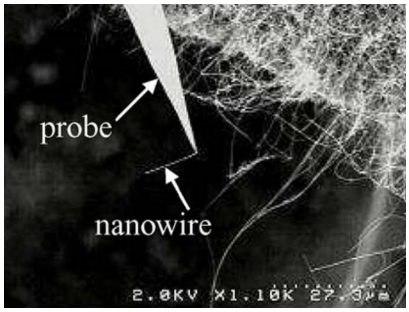
Nanomaterial Characterization

LifeForce enables electrical and mechanical measurements of micro-nano materials; and *in situ* interactions with nano structures. Example images show 4-point probing of and nano-tensile testing of nanowires.







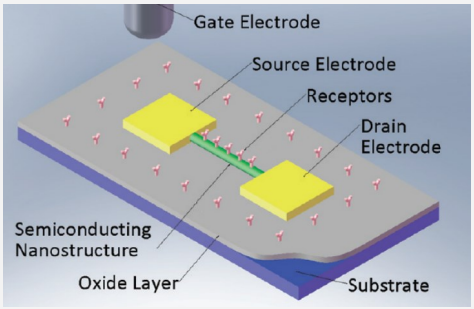


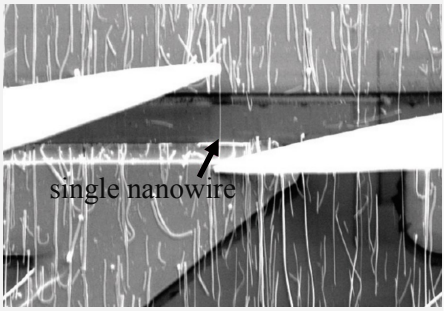
Pick-and-Place

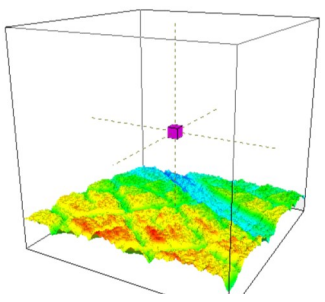
Using end-tools (e.g., probes, micro-nanogrippers, ultrasonic cutters), operator can operate LifeForce to push, pull, grasp, cut various micro-nano objects inside SEM.

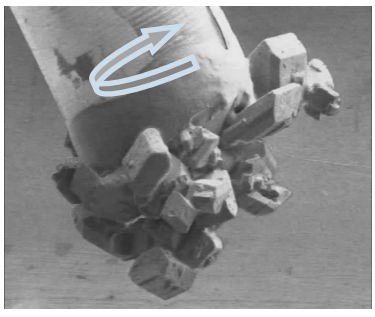
Micro-Nano Device Prototyping

Precise manipulator movements enable rapid prototyping or post processing of micro-nano devices. Example image shows the construction of nanowire FET sensors.









Add-On Tools

A growing list of upgrades are available for LifeForce system, including rotary stage, force sensor, microgrippers, gas injector, temperature stage, XYZ sample stage, and many more. Custom development are also available upon request.

For additional information, please visit www.to-nano.com or contact info@to-nano.com