

Xidex NanoBot[®] System

NanoBot Nanomanipulator Model NX-1000



Transform *your* SEM or FIB into a workshop for nanodevice fabrication and testing.

- Create your own applications with the NanoBot System's user-friendly LabVIEW™ virtual interface or select from built in applications.
- Install optional grippers, force sensors and Parallel Gas Injection for EBID/EBIE.
- Take real-time joystick control of the NanoBot.
- Choose the single handed NX-1000 or have the same controller drive a two handed NanoBot NX-2000, widening your range of applications.
- Save valuable lab space with the NanoBot System's compact, desk top control module.
- Achieve both long-range and fine-range motion in XYZ enabled by piezoelectric inertial drive.
- Drive your NanoBot System up to 12 mm in its Multi-Step mode, command a Single-Step of 50 nm to 2 μm , or park it and drive it up to $\pm 2.4 \mu\text{m}$ with $<1 \text{ nm}$ resolution in its Fine-Motion mode.
- Take advantage of the System's ultra-low drift and ultra-low electrical noise.

Applications:

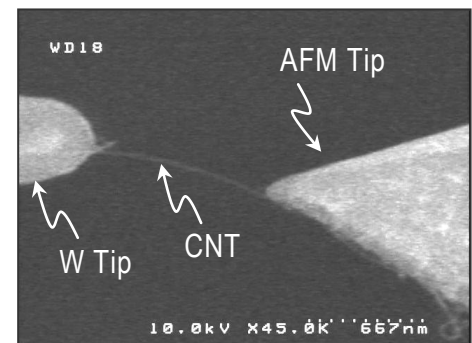
- Manual or automated manipulation of carbon nanotubes and other micro- and nano-scale objects.
- Electrical characterization of micro- and nanostructures.
- Force sensing, plus gripping with force feedback, for nanomaterial testing, pick-and-place, and other applications.
- Parallel Gas Injection System (PGIS) for nanomaterial editing, including TEM sample preparation.
- Xidex is extending the NanoBot Toolbox to new materials science, life science, and nanofabrication applications. These are being offered as options that include specialized end effectors and new LabVIEW virtual interface modules.
- Have a special research or manufacturing application in mind? You can drive it with your own custom built LabVIEW virtual interface. With Xidex's NanoBot System you can have it *your way!*

Features and Benefits:

The NanoBot System is designed for use inside a scanning electron microscope (SEM) or focused ion beam (FIB) tool. The two handed NanoBot NX-2000 can be controlled using the same desktop module by switching between right- and left-handed control. The product's compact overall size enables use in a wide range of SEMs and FIBs, including older model tools with smaller sample chambers.

In its Multi-Step mode the NanoBot nanopositioner can travel up to 12 mm in X, Y, and Z at speeds up to 1 mm/sec. Single-Step mode is adjustable from 50 nm to 2 μm . In Fine Motion mode, the NanoBot travels in a continuous range up to $\pm 2.4 \mu\text{m}$ with respect to its parked position in X, Y or Z with $<1 \text{ nm}$ resolution. Simultaneous XYZ travel is enabled in the Multi-Step, Single-Step and Fine-Motion modes.

The product package includes the nanomanipulator, vacuum feedthrough, mounting bracket adjustable to fit your SEM or FIB, low-noise coaxial/triaxial electrical cables, a compact desk top module that includes the controller, power supply and digital acquisition (DAQ) board, a joystick, and the LabVIEW user interface already installed on a laptop computer running Windows OS.



A 10 nm diameter CNT is placed along the side of an AFM tip during a CNT tip fabrication procedure using the NanoBot System. An electrical current pulse is subsequently used to cut the CNT away from the W tip.



Technical Specifications:

- **Number of XYZ positioners:**
NX-1000: 1, NX-2000: 2
NX-3000: 3, NX-4000: 4
- **Software:** A LabVIEW based applications library for mechanical and electrical probing and other useful procedures is already installed on a laptop computer running Windows. Additional applications are provided with grippers, force sensors and other optional end effectors. Other custom built user applications will require separate purchase of LabVIEW from National Instruments.
- **Compact desktop controller module:** One controller and joystick can drive up to four independent XYZ nanopositioners.
- **Joystick:** Controls all three axes of motion. Switchable between XYZ nanopositioners. Positions of previously selected nanopositioners are held fixed and retained in memory.

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NanoBot®

AC Parameters

X, Y Frequency: 100

X, Y Amplitude: 2.5

Z Frequency: 100

Z Amplitude: 2.5

AC-SS Parameters

X,Y AC-SS Amplitude: 2

Z AC-SS Amplitude: 2

AC-SS Frequency: 100

AC-SS Cycles in Z: 0

Actions

Surface Scan

STOP

Axis Motion Types

X, Y Motion Type: AC

Z Motion Type: AC

DC Parameters

X, Y Step Size: 0.1

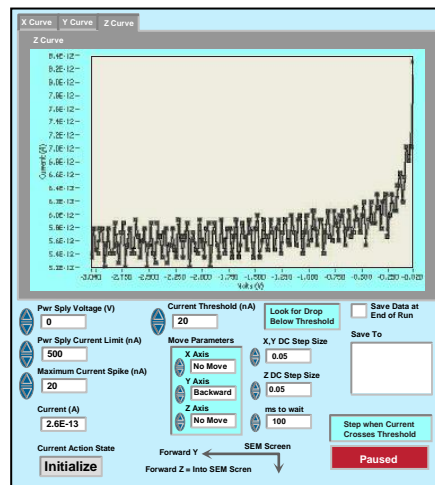
Z Step Size: 0.1

X Axis: 0

Y Axis: 0

Z Axis: 0

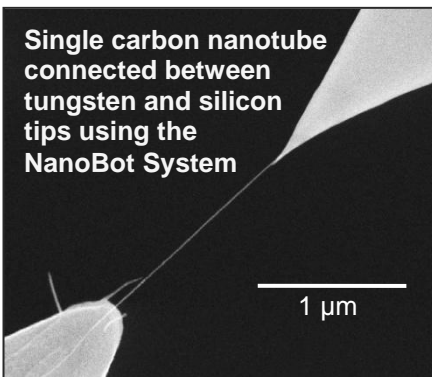
Manipulator 1



Example application interface for measuring the current-voltage curve of a nanodevice

End Effectors:

- Sharp metal electrical probe holder
- AFM cantilever holder
- Gripper with force feedback
- Force sensor
- Nozzle assembly of Parallel Gas Injection System (PGIS) for electron and ion beam induced deposition and etching



- **Actuation Modes:**

Long range	Range	12 mm
	Speed	up to 1 mm/sec
Single step		50 nm to 2 μm
Fine range	Range	± 2.4 μm
	Resolution	<1 nm
- **Drift:** <1 nm/min
- **Probe Electrical Characteristics:**

Electrical Noise:	<10 pA
Low Noise Option:	<200 fA
Maximum Voltage:	250 VAC
Maximum Current:	2 A
- **Size:** (excluding end effector booms)

(NX-1000)	54 x 28 mm	footprint
	34 mm	height
(NX-2000)	120 x 28 mm	footprint
	34 mm	height
- **SEM/FIB Mounting:** Mounts on SEM/FIB door or stage using an adjustable mounting bracket.
- **Electrical Connections:** Requires a KF40 port for electrical feedthrough. 100-240 VAC Input at 50/60 Hz.

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