Reference: DS006

NSCRIPTOR™ DPN® System

Dip Pen Nanolithography® (DPN) is the process of writing stable nanoscale patterns of molecular "ink" onto a sample substrate via a coated stylus tip (i.e., SPM probe). NanoInk has created a dedicated lithography system, the NSCRIPTOR DPN System, as a fully-integrated hardware and software system optimized for the DPN process. The foundational blocks of the NSCRIPTOR operation are based on the following fundamental tasks:

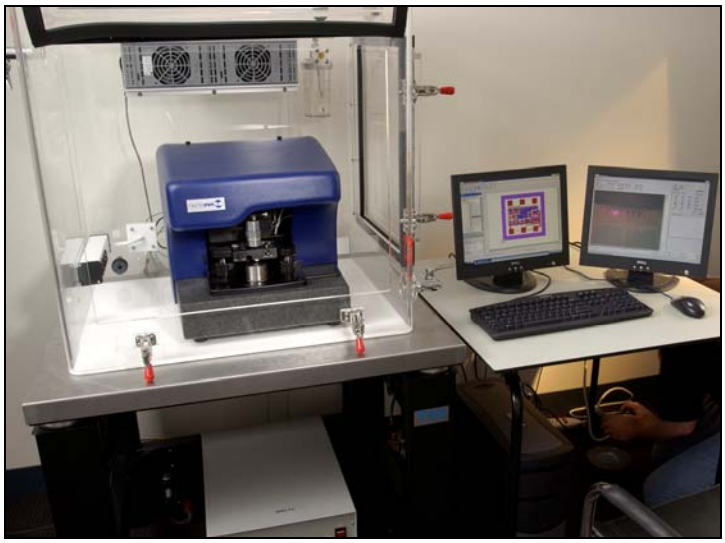
1. Prepare your working environment
2. Design your pattern in InkCAD or AutoCAD
3. Deposit your DPN pattern of molecules
4. Inspect your DPN pattern

SYSTEM HARDWARE

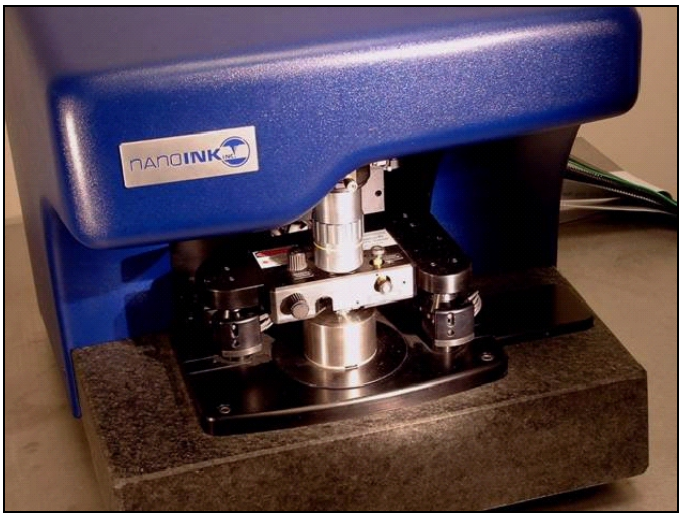
The hardware for the NSCRIPTOR system provides optimal performance for writing, alignment, sample navigation, and image acquisition.

The following features are critical for performing DPN experiments:

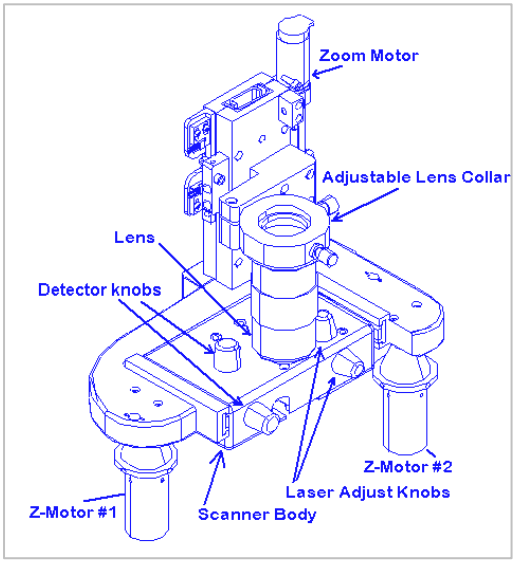
- Closed-loop scanning with high-linearity, high-speed scan capability and low drift rate
- Motorized three-point leveling of the X-Y scan plane relative to the sample surface
- High-quality optics for high-resolution video monitoring of the tip-sample relationship
- Scanning tip control improves operation with large samples, relative to sample scanning systems



NSCRIPTOR DPN System



DPN Stage



Scanner, Zoom Lens & Motors

DPN Stage

- Solid granite support base, size: 16” x 16” x 14”, weight: 122 lbs (loaded)
- Color CCD video camera with motorized zoom (4X) and focus capability
- High-quality 10x long working distance (LWD) lens mounted on an adjustable collar that allows panning the field of view over 1 mm of viewable travel
- Video magnification: 900X, with 260 x 340 micron field of view, 3 micron resolution
- Seven motors: two for X-Y sample puck translation, one for camera lens zoom, one for 10x lens focus, and three for Z-axis leveling and Z tip-approach
- 3 independently adjustable Z motors serve to level the plane of the scanner assembly
- X-Y sample translator motors: min. 3 micron step size, 1” x 1” travel, max. 2.5 mm/sec slew rate
- Sample holder is grounded, made of stainless steel disks with a central magnetic post
- Maximum sample size: 2” across, < 1.5” thick, and can be attached to a magnetic central post

DPN Scanner

- ≥ 90 micron scan X-Y range with better than 1% linearity (corrected)
- ≥ 8 micron Z range
- Noise floor < 0.1 nm in Z (when operated with complete damping of environmental noise)
- Scanning is performed with a tripod stack piezo configuration (i.e., independent X,Y,Z piezos)
- Closed-loop sensors perform calibration & linearization of piezo scanner in X, Y, and Z
- Scanner design with an aperture permits a top-view perspective for the optical microscope
- Pen changes are done with easy cassette-style loading onto the scanner assembly
- Pens are easily loaded into a metal tip clip and magnetically held onto the Z-scanner post

Supplied PC Configuration & Accessories

- Pentium® IV or latest equivalent architecture with minimum 3.0 GHz CPU with hyper threading technology for faster processing
- Minimum 1.0 GB RAM, 533 MHz DDR2 2x512
- 16X DVD+/- RW drive 48X/32X/48X
- 80 GB hard drive 8MB with data burst cache
- Dual video display card for dual LCD flat panel display configuration (17” and 17” display)

- Dual network card for communications and data access
- Digital video capture card for automated video alignment functions
- Floppy disk drive, 3.6 inch, 1.44MB
- 6 USB ports with an optical USB mouse and keyboard
- Microsoft Windows® XP Professional operating system
- Microsoft Windows® Office 2003 Basic Edition
- USB Web Cam QuickCam Fusion

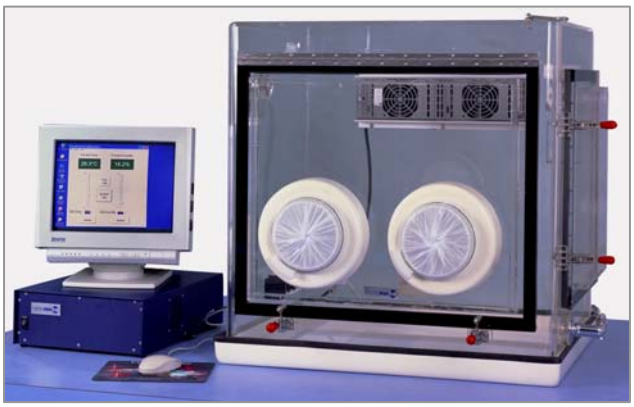
Control Unit

- Weight: 65 lbs., Size: 15” x 15” x 17”
- DC motor driver for approach @ ± 5 V, 150 mA
- DC motor driver for stepping @ 12 V max, 0.5 A max
- Four 16-bit ADCs: 4 input channels, ±10V, AC response to 500 kHz, DC to 20 kHz
- Sampling: 20 kHz @ 1 – 3 channels, 16 kHz @ 4 channels
- Output amps: 3 mV rms noise @ ground, for scanner & PID, over a 0 – 140 V range
- Auxiliary analog I/O: ± 10 V, 1.2 mV input @ 16 kHz rate, 2.4 mV output @ 10 kHz
- 4’ cables feed into back cable panel of environmental chamber
- Environmental limits: temp = 10 - 30°C, humidity = 5 - 60 % Rh (non-condensing)
- Electrical operation - voltage: 115/230 VAC, 50/60 Hz; current: 0.95/0.45 amp
- Ethernet™ communications between controller & user computers

E-Chamber™

NanoInk has integrated an environmental chamber as part of the NSCRIPTOR System, which controls the environmental conditions during DPN experiments. The chamber houses the entire DPN stage. Temperature and humidity sensors monitor the enclosed environment in real time, and both parameters are controlled by PID feedback loops. The system chamber is driven by a control module that is connected to the user PC. A PC-based software interface runs the E-Chamber from the PC.

- Box material: PolyCast™ cast acrylic
- Weight: 180 lbs
- Inside dimensions: 28” x 23” x 29”
- Outside dimensions: 34” x 30” x 36”
- Hospital-grade multiple electric outlet strip (mounted on the interior left side)
  - 2 gas valves for purging
  - Latched front access door and side access door
    - 1 pair of bare-hand-entry port conversions on front
    - continuous stainless steel hinges (mounted on the top)
    - 2 stainless steel fastening clamps on each door
    - access door opening on front is 24” wide x 20” high
    - access door opening on side is 15” wide x 18” high
    - specially mounted pressure relief valve (upper left hand side)
  - Bright white acrylic bottom with formed NORYL® reinforcement support
  - Rear connector panel for easy feed-through of cables to the stage



- External humidity and temperature control console, with dual digital PID feedback
  - PC-based software panel drives the power control console, connected via USB
  - Inert gas hook-up and nebulizer (required for using the humidity control functions)
  - Temperature control uses a 121-watt thermoelectric fan system for convective heating
- Sensor array components:
  - Humidity sensor (with 8' cable)
  - Temperature sensor (with 8' cable)
  - Pressure relief valve
  - Nebulizer On/off switch
- Humidity control performance specifications:
  - Humidity range: min. = 5% Rh, max. = 75% Rh (below dew point)
  - Setpoint stability: ± 0.5 % Rh
  - Sensor resolution: ± 2.0 % Rh
  - Overshoot amplitude: 0.1 % Rh @ 60 % Rh from a 15% up-ramp
  - Humidification ramp rate: 3% Rh/minute (> 15 % Rh range using a range > 15% Rh)
  - Dehumidification ramp rate: -1% Rh/minute (over 20 % Rh) using an air compressor. Note: using nitrogen instead of air will enhance this process.
  - Maximum vacuum: ≈ 0.2165 PSI or 1.493 KPa
- Temperature control performance specifications:
  - Temperature range: min. = 2°C less than room temperature; max. = up to 10°C greater than room temperature
  - Setpoint stability: ±0.2 °C (given a stable room temperature)
  - Detection resolution: 0.1 °C for full scale
  - Overshoot amplitude: 0.5°C
  - Heating ramp rate: 0.26°C/minute without DPN stage
  - Equilibrated heating ramp rate: 0.07°C/minute with DPN stage in chamber
  - Programmability: software stabilizes temperature to a desired setpoint

Vibration Damping Table

- 30" L x 30" W stainless steel work surface
- Highly damped, high stiffness leg frame in a full bench design
- Active vertical damping and horizontal compensation with Micro-g Gimbal Pistons
- Isolation efficiency up to 85% / 95% @ 5Hz / 10 Hz respective vibration periods
- 2 Hz natural frequency in vertical and horizontal vibration periods
- 350 lb net load capacity
- Net weight 480 lbs

SYSTEM SOFTWARE – InkCAD™

InkCAD software is the user interface for driving the NSCRIPTOR DPN System, and provides full-featured, industrial-strength capability. Supporting a true CAD capability, it goes well beyond what any commercial AFM nanolithography packages can offer. In addition, InkCAD software provides a comprehensive set of tools for tackling all DPN research experiments. For those users that need AFM functionality and control, NanoInk provides a research AFM software package as standard "freeware" with your system.

InkCAD controls the scanning probe interface for DPN tasks. As such, InkCAD software provides a

comprehensive set of lithography tools as well as complete imaging capabilities that are required for examining DPN patterns. In addition to providing complete control over the scanning probe hardware, InkCAD has the following main DPN design, patterning and critical navigational capabilities:

- Simple pattern-creation routines for easy DPN experiments
- Layered structural hierarchy for sophisticated pattern design, with organizational tools for the individual design elements
- The ability to import and write complex CAD patterns from GDS II format files
- Automated alignment and calibration routines for more productive DPN process control
- The ability to image specific areas on a sample surface and then use this sample information to write a prescribed pattern into that same area

For a detailed description of InkCAD software, please consult the InkCAD data sheet (DS008).

NanoInk offers a complete DPN solution:

Simple Solutions for Nanofabrication

▪ Minimum line width < 30 nm ▪ Layer to layer feature alignment < 150 nm ▪ Supports parallel pen writing	▪ Custom software control ▪ Individual temperature and humidity control ▪ Precise feedback loop readings
▪ Nanoscale navigation with integrated coordination of the tip, sample stage and scanner ▪ Image and video storage database ▪ Excellent image resolution in contact and AC modes	▪ Latest in lithography technology via DPN ▪ AutoCAD compatible import via GDS format ▪ Complete operational AFM capability

For more information, please contact NanoInk at info@nanoink.net or 1-847-679-NANO (6266).

All specifications listed are presented as attainable capabilities *only* with NanoInk's provided materials.