

## DPN Pens: 2D nano PrintArray

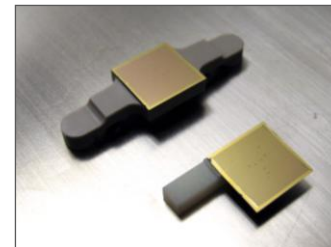
Dip Pen Nanolithography<sup>®</sup> (DPN<sup>®</sup>) is the process of writing nanoscale patterns of "ink" onto a sample substrate via a coated SPM tip. The 2D nano PrintArray<sup>™</sup> (2DnPA) expands the capabilities of conventional DPN by providing an array of 55,000 identical cantilevers attached to a single silicon chip.

The 2D nano PrintArray has the same lithography advantages as single tip DPN, including force independence, a wide variety of inks and substrates available for printing, and the ability to direct write at high resolution under ambient conditions. With the 2D nano PrintArray you can replicate nanometer features of a variety of molecular inks simultaneously over cm<sup>2</sup> areas. The 2DnPA chip can be used in conjunction with NanoInk's DPN instruments and accessories, including the NLP 2000, DPN 5000, and NSCRIPTOR<sup>™</sup>. The device mounting and leveling procedure varies between the instruments, but once leveled, it is easy to generate nanoscale features over large areas with a lateral resolution down to 100 nm.

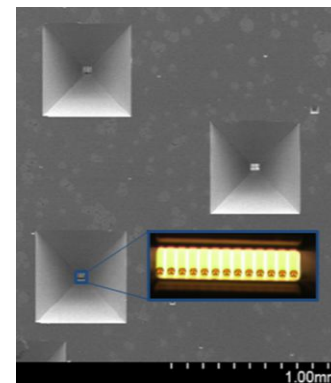
### Cantilever Specifications

The 2D nano Print Array cantilevers are silicon nitride designed for contact mode printing with 6-14  $\mu\text{m}$  freedom of travel. They are attached to a 1 cm<sup>2</sup> silicon wafer with 6 view ports to detect cantilever contact with the surface (see Figure 2). These viewports are used for planar leveling of the array. There are also 4  $\mu\text{m}$  pillars at the corners of the silicon chip which prevent the cantilevers from destruction if the 2DnPA is pressed too hard into the surface (see Figure 3).

With the device mounted and leveled, it is easy to generate nanoscale features over large areas. Throughputs range from  $1 \times 10^7 \mu\text{m}^2$  per hour to  $3 \times 10^{10} \mu\text{m}^2$  per hour.



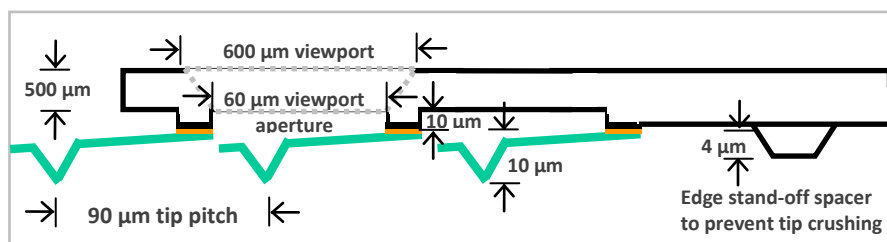
**Figure 1:** 2DnPA Chips affixed to plastic wedges. Designed for the NLP 2000 System (left) and for the DPN 5000 System (right).



**Figure 2:** SEM image of the back side of the 2DnPA chip. Three of the viewports are displayed. The cantilevers can be seen through the viewports to determine contact with the substrate.

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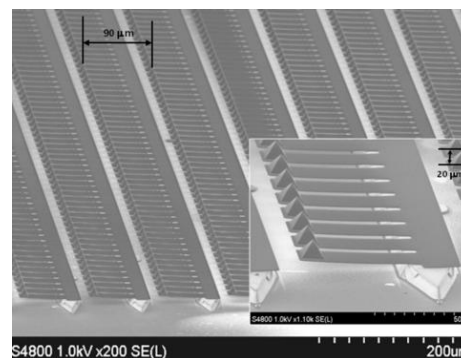
(continued)



**Figure 3:** Dimensions of the 2D nano PrintArray™ chip and cantilevers (*not to scale*).

2DnPA: Chip Specifications	
Chip dimension	1 cm x 1 cm
Viewport windows	6
Rows of cantilevers	110
Columns of cantilevers	500
Number of cantilevers	< 55,000*
Edge space columns	4
2DnPA: Cantilever Specifications	
Cantilever stiffness, $k$ (N/m)	~ 0.20 N/m
Cantilever width ( $\mu\text{m}$ )	15 $\mu\text{m}$
Cantilever length ( $\mu\text{m}$ )	60 $\mu\text{m}$
Cantilever-cantilever pitch ( $\mu\text{m}$ ) in X	20 $\mu\text{m}$
Cantilever-cantilever gap ( $\mu\text{m}$ ) in X	5 $\mu\text{m}$
Cantilever-cantilever pitch ( $\mu\text{m}$ ) in Y	90 $\mu\text{m}$
Cantilever curvature	~ 6°
Tip height ( $\mu\text{m}$ )	7.5 $\mu\text{m}$
Tip radius, unsharpened (nm)	35 nm (+/- 10)
Tip radius, sharpened (nm)	15 nm (+/- 5)

\*>98% intact operable cantilevers



**Figure 4:** SEM image showing rows of cantilevers attached to the silicon ridges. The inset shows individual cantilevers, while highlighting the 7.5  $\mu\text{m}$  tall tips and inherent cantilever curvature.

### Printing Materials and Substrates

Ink materials used so far include MHA, ODT, and the phospholipid 1, 2-dioleoyl-*sn*-glycero-3-phosphocholine (DOPC). Substrates used include silicon, glass, titanium, and hydrophobic polystyrene.

### Ordering Information

Item Name: Pens, 2D nano PrintArray™

Part #: NLP-0301-01

Compatible with NLP 2000 System, DPN 5000 System, and NSCRIPTOR™ DPN System

Learn more about NanoInk products and services at [www.nanoink.net](http://www.nanoink.net). Or call us at 847-679-NANO (6266).