

## Just Add DNA™ NanoInk's Optimized Accessories and Process for DPN® of DNA Nanoarrays

by Sergey Rozhok, Emma Tevaarwerk, Mohammed Parpia, and Joe Fragala

### Introduction

Nanoscale patterning of DNA via Dip Pen Nanolithography® (DPN®) was originally demonstrated in 2002 by Demers et al[1], and has since grown in popularity as a tool for creating multiplexed DNA nanoarrays. DNA nanoarrays offer several advantages over their microarray counterparts; most notably, they could hold between  $10^4$  to  $10^5$  times more features than conventional microarrays, and as a result, a larger number of targets could be rapidly screened in each experiment[2]. Another distinct advantage is that it requires significantly smaller volumes of materials. NanoInk has worked to optimize DNA writing, creating tailored inks, cantilevers, and microfluidic ink delivery wells—the “Just Add DNA” accessories and protocol.

### Just Add DNA

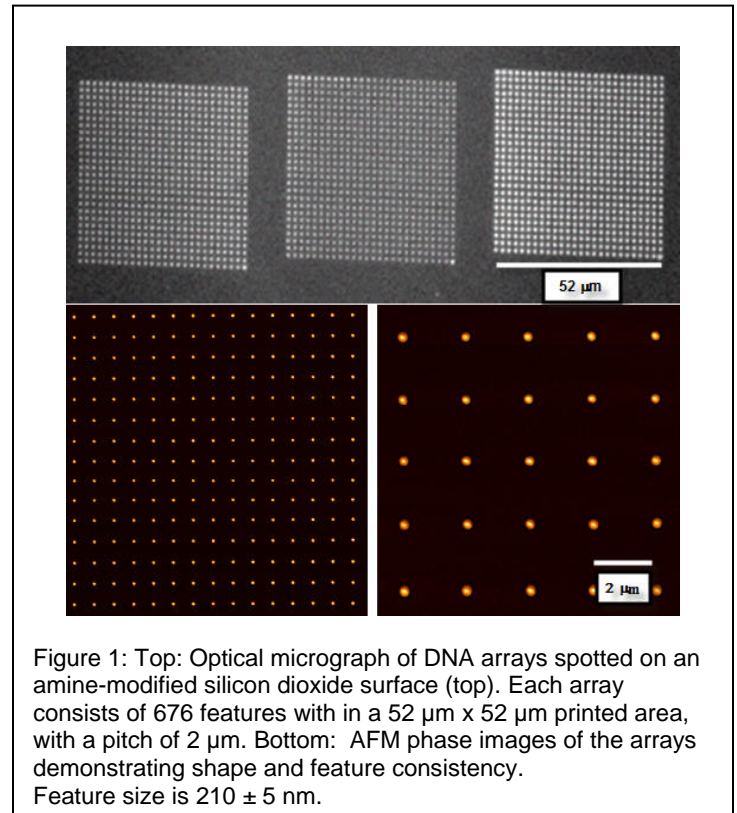
Just Add DNA represents the most recent developments in DPN patterning of biological molecules and provides all of the tools along with the knowledge necessary to successfully produce nanoscale DNA dot arrays via Dip Pen Nanolithography.

The Just Add DNA kit includes:

- 1) Inks - consisting of everything but the DNA, which you add just before you are ready to pattern.
- 2) Pens - specially designed 12-pen cantilevers with a high spring constant for delivering inks to a substrate.
- 3) Inkwells - corresponding microfluidic inkwells for the delivery of inks to the multi-pen cantilevers.
- 4) Silicon substrates for patterning the ink.
- 5) User Guide - a document describing how all of these tools combined can be used with the NSCRIPTOR™ DPN System to deposit nanoscale DNA patterns.

### DNA Inks

Formulation of inks is key for successful tip coating and subsequent nanoscale patterning via DPN. To achieve deposition of submicron features it is important that inks spread evenly over the cantilever surface to form a thin layer. The DNA carrier inks consist of two optimized components (solutions A and B), which when combined with DNA and used according to NanoInk's protocol, enable easy ink flow and slow drying, in addition to demonstrating an affinity to the substrate.



### DNA Pens

The parallel pens, exclusively available from NanoInk, are key both for increasing the through-put of the patterning process[3], and also for multiplexed ink delivery. A single pen can deliver an array of 10,000 spots in a 100  $\mu\text{m}$  x 100  $\mu\text{m}$  area in less than an hour[4], whereas multiple pens can produce up to twelve times that in the same period of time. The DNA cantilevers have a spring constant of 3.0 N/m, to allow viscous inks such as DNA to be deposited more easily.

### DNA Inkwells

The corresponding DNA Inkwell's are tailored to the pitch of the DNA cantilevers, and allow for up to six different inks to be loaded simultaneously onto the cantilevers. Each inkwell reservoir can be loaded with 0.3  $\mu\text{L}$  of ink, which then reaches the microwells via specially engineered microfluidic channels. Once inked, each pen dispenses tens of femtoliter volumes of DNA ink to the surface, producing DNA arrays with dots as small as 200 nm. Figure 1 shows arrays of amine-modified DNA oligonucleotides.

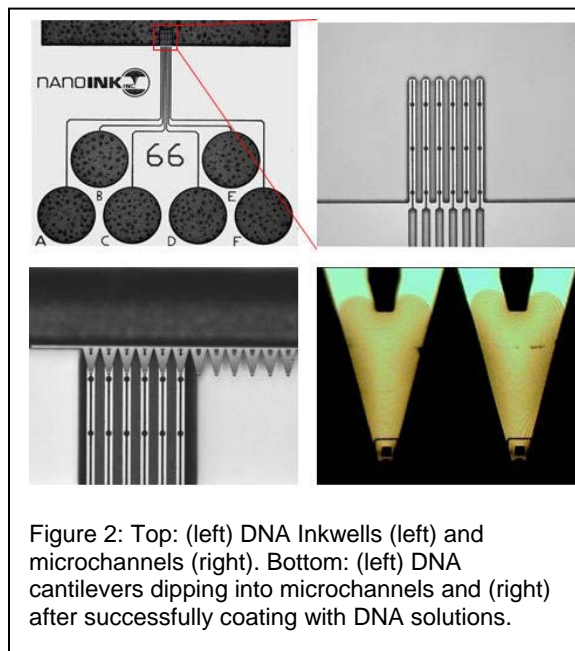


Figure 2: Top: (left) DNA Inkwells (left) and microchannels (right). Bottom: (left) DNA cantilevers dipping into microchannels and (right) after successfully coating with DNA solutions.

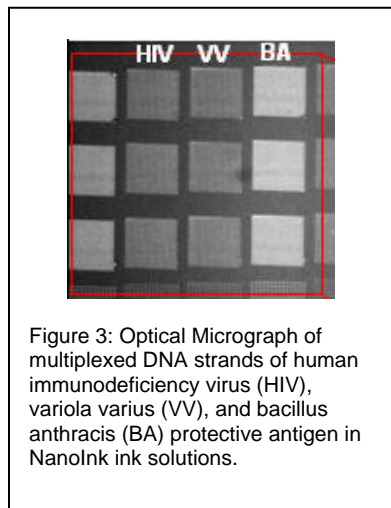


Figure 3: Optical Micrograph of multiplexed DNA strands of human immunodeficiency virus (HIV), variola varius (VV), and bacillus anthracis (BA) protective antigen in NanoInk ink solutions.

Finally, and most importantly, NanoInk's Inkwells allow the cantilevers to be simultaneously inked with **different** strands of DNA. Figure 3 shows an optical micrograph of DNA containing strands of human immunodeficiency virus (HIV), variola varius (VV), and bacillus anthracis (BA) protective antigen delivered to the surface using NanoInk's "Just Add DNA" ink solutions.

For more information including pricing, please contact NanoInk Sales Department at [sales@nanoink.net](mailto:sales@nanoink.net) or 1-847-679-NANO.

### References

1. Demers, L.M., et al., *Direct patterning of modified oligonucleotides on metals and insulators by dip-pen nanolithography*. Science, 2002. **296**(5574): p. 1836-1838.
2. Salaita, K., Y.H. Wang, and C.A. Mirkin, *Applications of dip-pen nanolithography*. Nature Nanotechnology, 2007. **2**(3): p. 145-155.
3. Haaheim, J., et al., *Dip Pen Nanolithography: A Maturing Technology for High Throughput Flexible Nanopatterning*. Proceedings of the Nano Science and Technology Institute, 2007(May 2007).
4. Rozhok, S., et al., *Direct Parallel Patterning of Multiplexed DNA and Protein Arrays*. Accepted to Proceedings of the Nano Science and Technology Institute, 2007.

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