Multiplexing and Transport Phenomena in Dip-Pen Nanolithography

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Tip-based nanofabrication (TBN) relies on nanoscale spatial control and radius of scanning probe tips to create desired features on a surface with nanometer registration and feature size. In particular, dip-pen nanolithography (DPN) has proven to be a versatile technique for constructively patterning biological, organic, and inorganic "inks" because of its unique patterning mechanism whereby material is transferred from an atomic force microscope tip to a surface through a water meniscus[1]. Two challenges for DPN and more broadly, TBN, include (1) the ability to pattern different materials at the same time and (2) the ability to control and predict material transport rates. We have developed multiplexed, massively parallel DPN[2] and an understanding of mass transport phenomena[3]. For this work, a piezo-controlled inkjet printer dispenses picoliter volumes of ink (e.g. phospholipids) to tips in an array (Figure 1A), enabling hundreds of materials to be patterned simultaneously. Because of the control and consistency afforded by the inkjet printer, we are also able to investigate DPN-related transport phenomena. We have found that with a well-studied DPN system—16-mercaptohexadecanoic acid—the transport rate increases with more drops of ink (Figure 1B). This poster will show developments and progress in multiplexed DPN, related transport behavior, and steps toward the synthesis of inorganic nanoparticles on a surface.

[1]K. Salaita, Y. H. Wang, C. A. Mirkin, Nature Nanotechnology, **2**, 145 (2007).
[2]Y. H. Wang, L. R. Giam, M. Park, S. Lenhert, C. A. Mirkin, Small, **4**, 1666 (2008).
[3]L. R. Giam, Y. H. Wang, C. A. Mirkin, Journal of Physical Chemistry C, *In press*.

(A) (B)

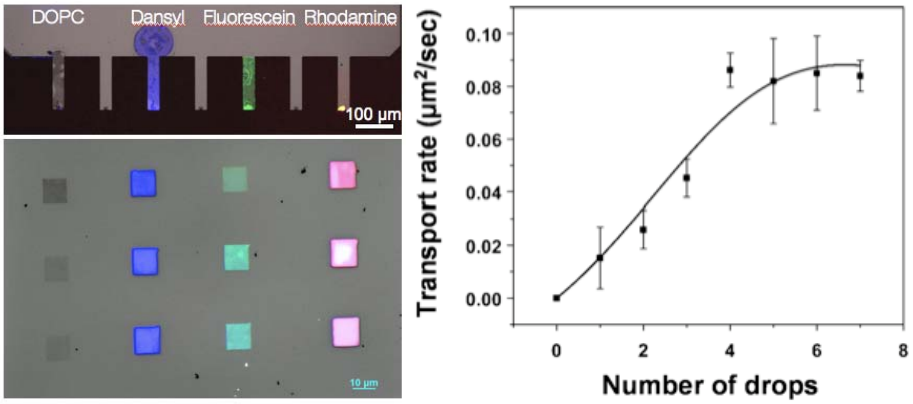

Fig 1: Multiplexing and Transport Phenomena in DPN: (A) Fluorescence micrograph of a one-dimensional pen array inked with 1,2-Dioleoyl-*sn*-Glycero-3-Phosphocholine (DOPC) mixed with fluorescently-labeled phospholipids (dansyl, fluorescein, rhodamine). (B) The transport rate of MHA as a function of the number of MHA-ethanol drops inked on the tip.