Electronic Supplementary Information for:

Inkjet Printing on Transparency Films for Reagent Storage with Polyester-Toner Microdevices

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Table of Contents

Printing reagents onto polyester layers

Initial attempts to print onto TRANSNS transparency film were unsuccessful due to the non-absorbent characteristic of the film. Initiating the printing process onto paper overlapped with transparency circumvented this limitation and once a print stream was created, it was maintained when moved to transparency (Figure S-1). This methodology could not be used moving forward, because it made printing more complex device designs difficult. Patterning onto paper between each printing event wasted valuable reagents and increased device fabrication time. Additionally, this method limited the device layer designs, requiring reagent-patterning spots to be positioned for intermittent printing onto the alignment filter around the transparency film.

Secondary attempts to print directly onto transparency films involved the addition of additives to the reagent matrix. The Ohnesorge number (Equation 1) was used to predict printability of solutions, defining good printability as a ratio of reagent properties and inkjet print head diameter.[1,2] Various additives were used following the Ohnesorge parameters, including polyethylene glycol and glycerol to increase solution density and viscosity, and surfactants to decrease surface tension. If the viscosity of the solution was too high, the force generated by the piezo was insufficient to eject the droplet and make contact with the substrate, thus causing the droplet to retract into the print nozzle and dry.[3] Once the droplet dried, this became a common source for clogging of the print head and would require substantial syringe pressure and cleaning to dislodge the dried print solution. When the concentration of surfactant was in excess, adjacent droplets would combine and result in a droplet that was too large to dry onto the printing surface (Figure S-1). Although some successes resulted using additives incorporated into the reagent solution, overall printing was inconsistent and, frequently, the printer nozzle would become clogged.

[1] B. Derby, *Annu. Rev. Mater. Res., Vol 40*, 2010, **40**, 395-414.
[2] M. Singh, H. M. Haverinen, P. Dhagat and G. E. Jabbour, *Adv. Mater.*, 2010, **22**, 673-685.
[3] J. T. Delaney, Jr., P. J. Smith and U. S. Schubert, *Soft Matter*, 2009, **5**, 4866-4877.

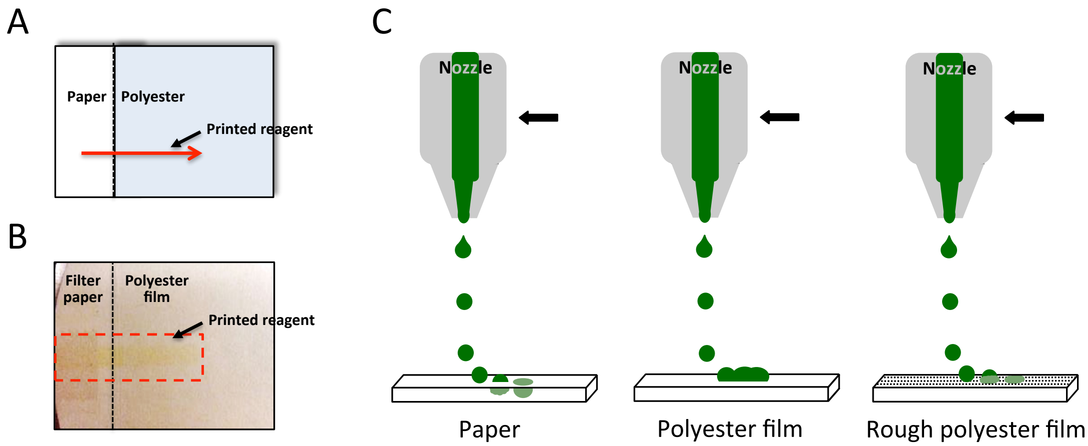

Figure S-1. Inkjet printing droplets onto various substrate material. (A) Diagram describing initial attempts of printing reagent onto polyester film by overlapping paper with transparency, starting the print stream on paper to maintain printing onto the polyester film. (B) Actual image of printed TBPB reagent (yellow) onto polyester film using filter paper to initiate printing. (C) Schematic showing inkjet printing demonstrating droplet interactions with different microdevice material. When droplets are printed onto paper, the droplets get absorbed into the porous cellulose-based substrate and dry. Non-porous polyester film does not absorb the printed droplets causing multiple droplets to combine on the surface and no drying occurs. Inkjet polyester film with a rough surface allows more surface area for the printed droplet to interact with and dry onto the surface.