Electronic Supplementary Material (ESI) for Lab on a Chip.

Supporting information for

Rapid Flow in Multilayer Microfluidic Paper-Based Analytical Devices

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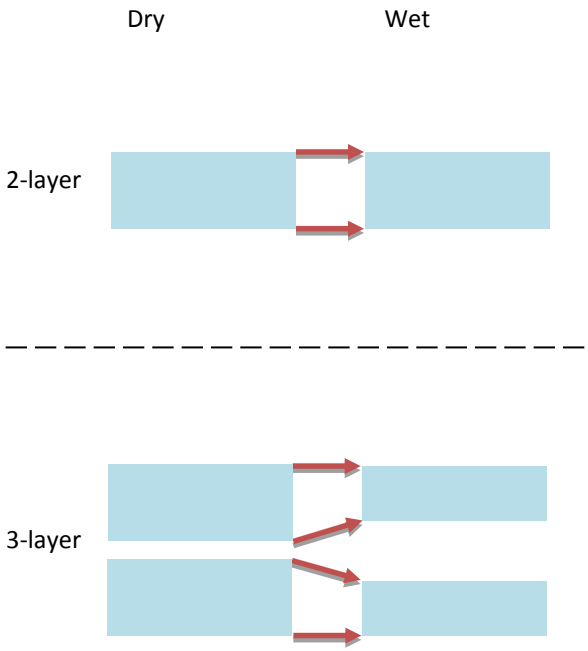

Figure S1. Side on illustration of swelling in 2- and 3-layer µPADs, where blue is fluid, red is paper and grey is the tape sealing. Note that as the paper wets, the channel height in the 2-layer device stays the same as the paper pushes on the tape, but the channel height is reduced in the 3-layer device due to swelling of the middle paper layer (red arrows).

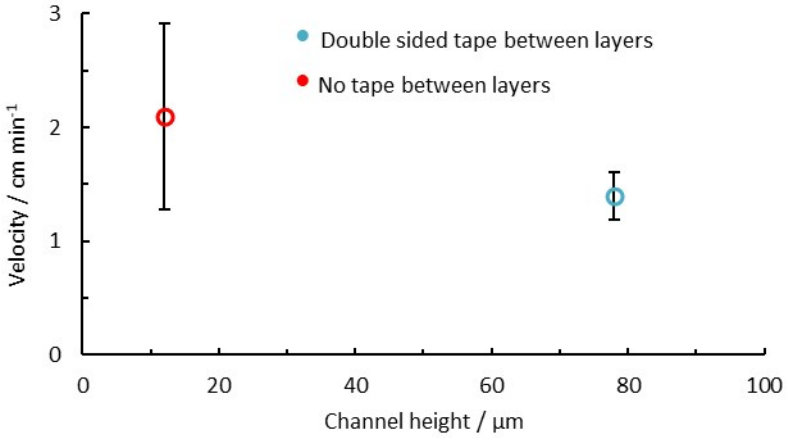

Figure S2. Effect of confining channel height with or without double sided sticky tape on the velocity for multilayer µPADs, vertical orientation, (n = 5) flow taken up to 5.55 cm. The channel height for the untapped device is an estimate based on previous multilayer µPAD publications.[1, 2]

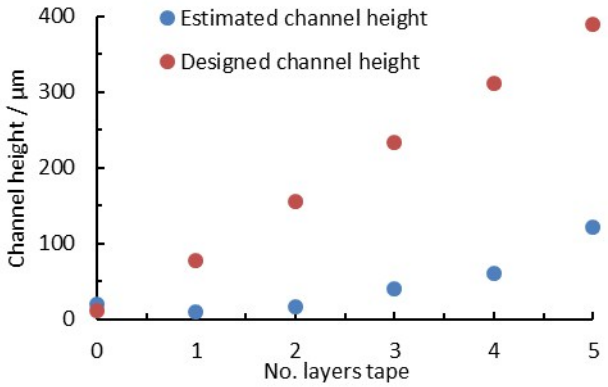

Figure S3. Estimated channel height from theoretical models based on the observed device velocities and actual channel height based on design of the multilayer µPADs, for horizontally orientated devices.

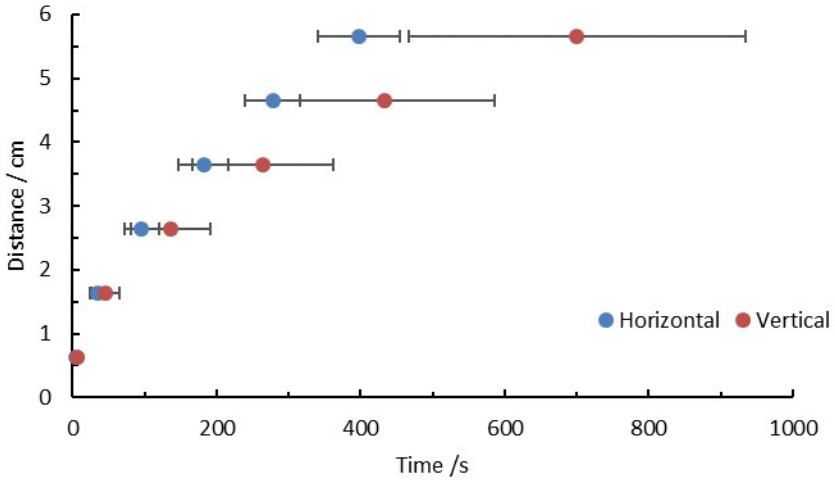

Figure S4. Length traversed down straight channel 1-layer of paper µPADs with horizontal and vertical orientation (n = 5).

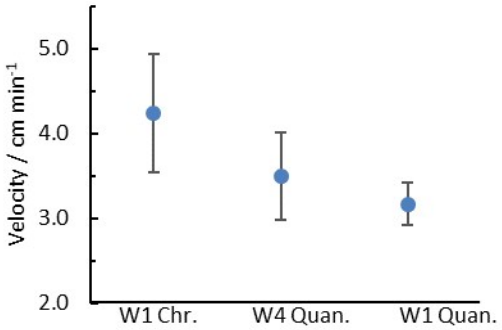

Figure S5. Effect of paper type on flow rate using vertical µPADs with 3 layers of tape between the two paper layers. Velocity is calculated for flow up to 5.55 cm (n = 5).

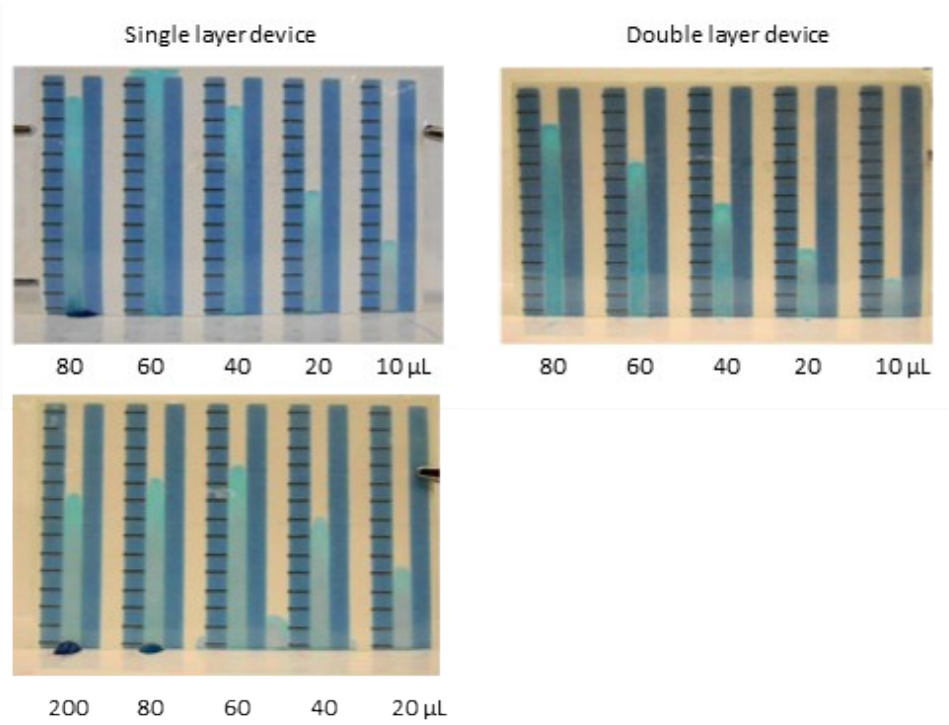

Figure S6. Photographs of volume dependent fluid transport in single vs double layer devices, as described in Figure 5 of the main paper. Top: comparison of single and double paper layer devices with 10, 20, 40, 60, and 80 µL dye. Bottom: snapshot of single layer device during flow, showing slower flow rates at inlet volumes above 60 µL.

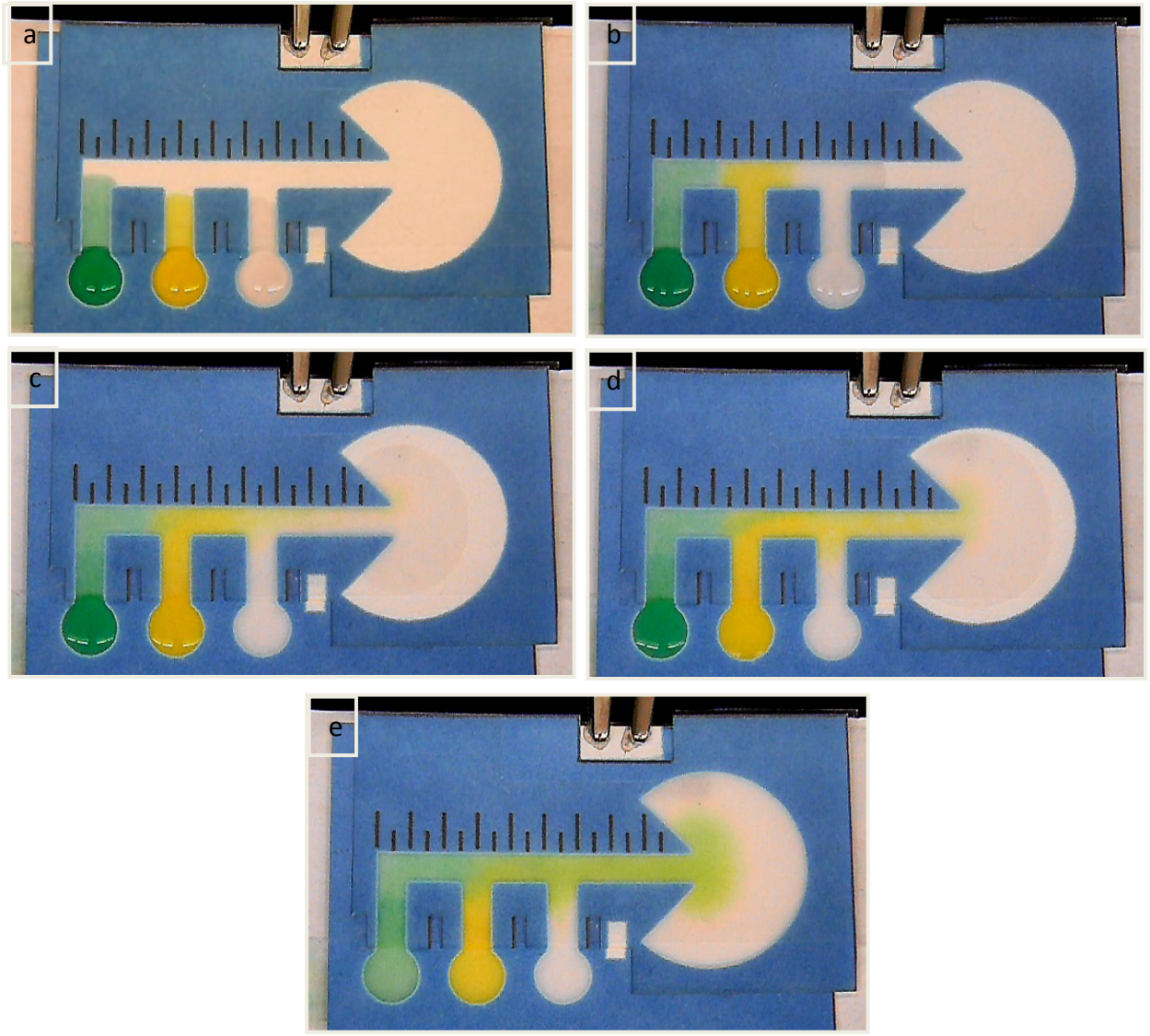

Figure S7. Images of a multilayered 3DPN device using 3 layers of tape between the layers, at different stages of sequential injection (Figure 6 if main paper, blue line). The 80 µL injections from right to left are as follows: KNO_3, 1 mM $FcTMA^+$ with 0.1 M KNO_3 spiked with a yellow dye, and finally 0.1 M KNO_3 spiked with a green dye. The snapshots represent a) addition of sample to wells and wicking up the inlet legs, b) KNO_3 reaching the electrodes, c) $FcTMA^+$

reaching the electrodes, d) The maximum current signal from the $FcTMA^+$ injection, e) the final (wash) KNO_3 injection washes the $FcTMA^+$ past the electrode and the flow ceases as the fan is filled and the sample wells are depleted.

REREFENCES

1. J. A. Adkins, E. Noviana and C. S. Henry, *Anal. Chem.*, 2016, **88**, 10639-10647.
2. C. K. Camplisson, K. M. Schilling, W. L. Pedrotti, H. A. Stone and A. W. Martinez, *Lab Chip*, 2015, **15**, 4461-4466.