3D-Printed Fluidic Devices with Integrated Electrodes Prepared by Fused Filament Fabrication

Supporting Information

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Channel Measurements. Partially printed channels were filled with a 1 mM methylene blue in 10 mM phosphate buffered saline (PBS), pH 7.4 to assess printer performance by comparing measured dimensions to the dimensions specified in the design file. Images of filled channels were obtained using a Firefly GT800 microscope (Belmont, MA, USA) and channel dimensions were measured using ImageJ software.[1] Fifteen measurements of channel height and width were taken from 22 mm-long channels.

Three-sided channels were prepared in order to compare dimensions of the printed objects with the original designs. Channels were designed with an open side (Figure S1A) to evaluate height and an open top (Figure S1B) to evaluate width. The shapes of channel cross-sections were also evaluated using open-ended channels (Figure S1C-E). Channels with square cross-sections were actually rectangular with height being consistent with the design size while width was consistently smaller than design size (Figure S1C-F). Standard deviations for measurements of single channels were 8-18 μm (≤7.5%), and average measurements for three different channels with the same designed height or width varied by <5%.

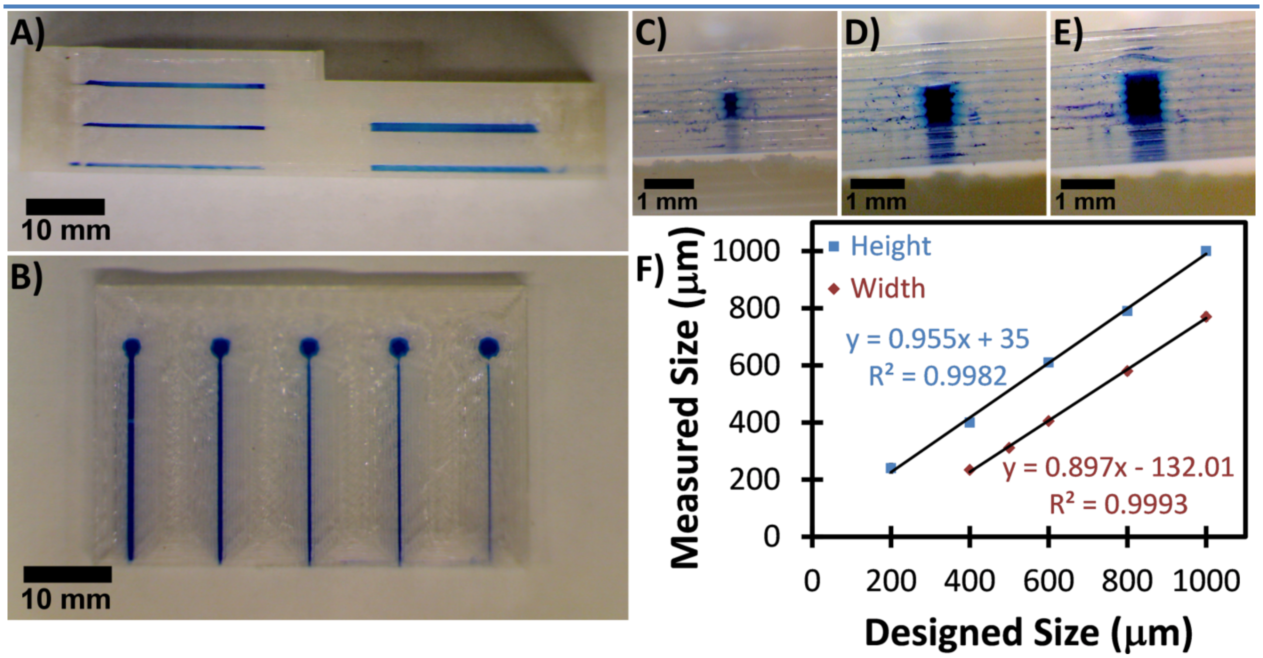

Figure S1. 3-sided channels filled with methylene blue solution to evaluate channel height and width. Side views of channels designed to have (A) heights and (B) widths of 200, 400, 600, 800, and 1000 μm. Images of open-ended channels designed to have square cross-sections with dimensions of (C) 600, (D) 800, and (E) 1000 μm. F) Relationships between average dimensions of 3D-printed channels (n = 15) and original design size.

PET and ABS/PET 3D-Printed Fluidic Devices. Devices were printed either entirely with PET (Figure S2A,B) or with a combination of opaque ABS and clear PET (Figure S2C,D) through dual-extrusion. The channels were designed to be 800 μm x 800 μm x 56 mm with a volume of 36 μL. The ABS/PET combination devices featured a single 200 μm-thick bottom layer of PET to enable visualization of the dye solution in the channel from the underside of the device (Figure S2D).

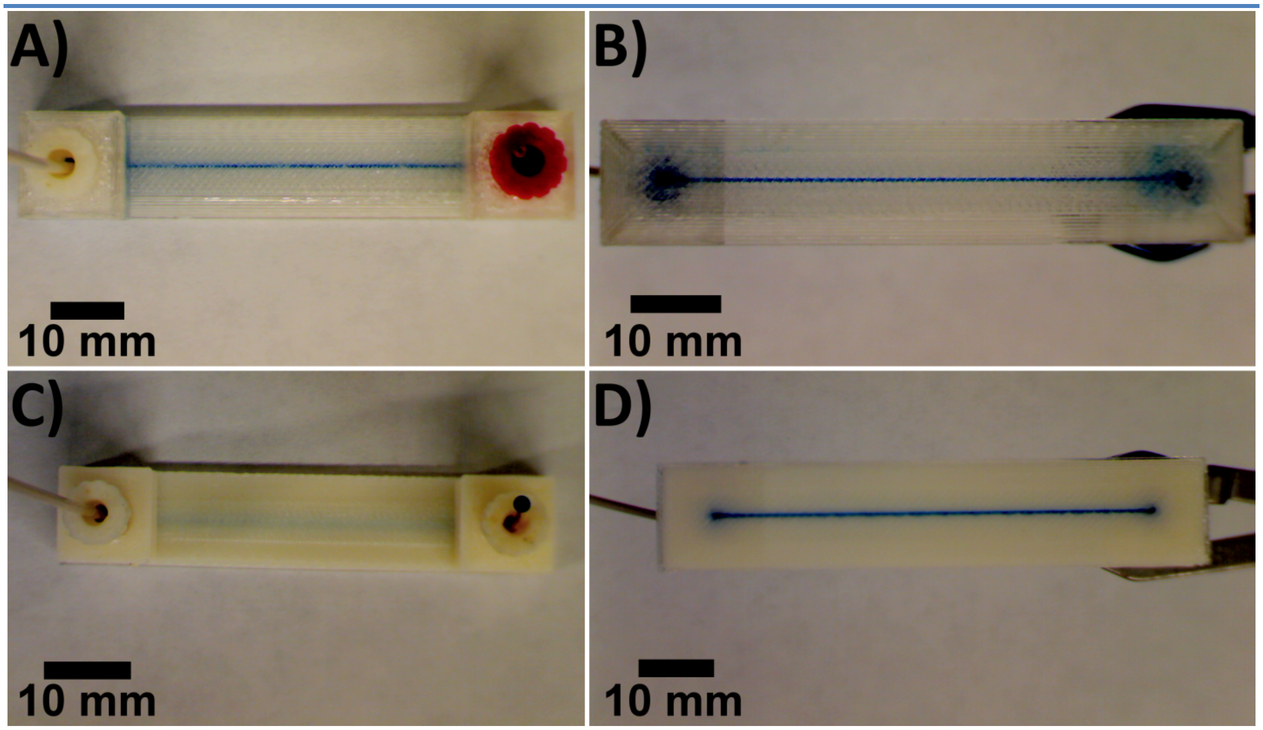

Figure S2. PET and ABS/PET 3D-printed fluidic channels. Top (A) and bottom (B) views of PET device with channel designed to be 800 μm x 800 μm. Top (C) and bottom (D) views of ABS/PET device with bottom 200 μm thick layer of PET.

Integrated Electrodes in 3D-Printed Channel for Electrochemical Measurements. Cyclic voltammetry (CV) was performed in 1 mM ferrocene methanol with 0.1 M KCl using an electrode fitting that featured 0.25 mm Pt working, 0.5 mm Au counter, and 0.5 mm Ag/AgCl reference electrodes. Excellent agreement in CV response was obtained for the fitting in the 3D-printed channel and in a beaker filled with solution (Figure S3A), indicating the utility of the integrated electrodes for electrochemical measurements. The integrated electrodes exhibited typical linear relationship between peak current and the square root of scan rate (Figure S3B).

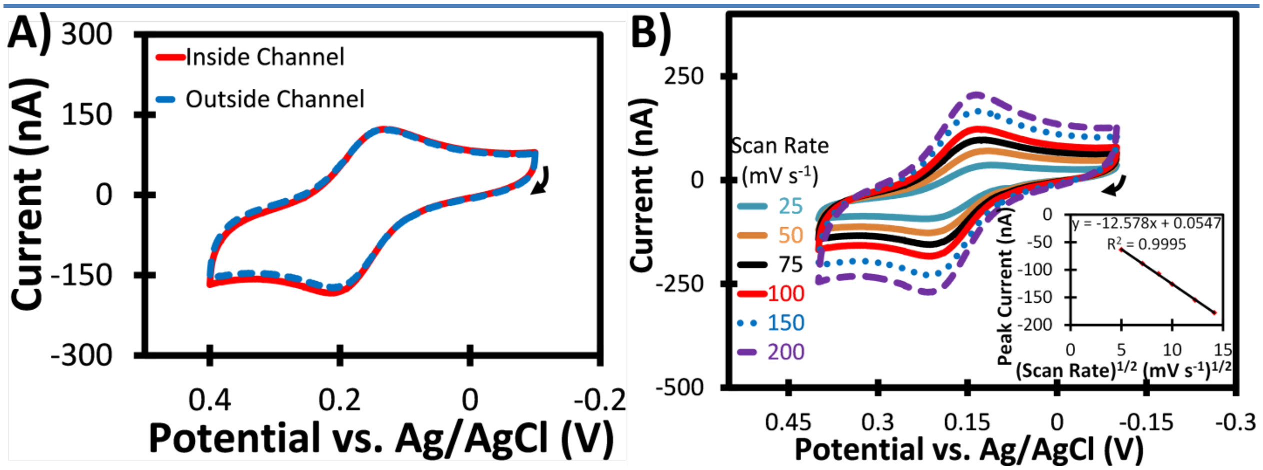

Figure S3. Cyclic voltammograms of 1 mM ferrocene methanol in 0.1 M KCl for fitting with 0.25 mm Pt working, 0.5 mm Ag/AgCl reference, and 0.5 mm Au counter electrodes. A) CV response for the electrodes inside the microfluidic channel and outside the channel (in a beaker). B) Dependence of CV response on scan rate for electrodes integrated in microfluidic channel depicting linear relationship between anodic peak current and square root of scan rate (inset). Arrows indicate the direction of scan.

References

[1] Schneider, C. A.; Rasband, W. S.; Eliceiri, K. W. *Nat. Methods* **2012**, *9*, 671-675.