Electronic Supplementary Material (ESI) for Analytical Methods

Supplemental Information for: *Encapsulation of Fluidic Tubing and Microelectrodes in Microfluidic Devices: Integrating Off-Chip Process and Coupling Conventional Capillary Electrophoresis with Electrochemical Detection*

Additional Experimental Information

Imaging. All images, except for desegmentation interface shown in Figures 1E-F, were obtained using a fluorescence microscope (IX71, Olympus America) equipped with a 100 W Hg arc lamp, fluorescein filters, and a cooled 12-bit monochrome Qicam Fast digital CCD camera (QImaging, Montreal, Canada). Images were captured with Streampix Digital Video Recording software (Media Cybernetics, Silver Spring, MD, USA). For studies involving measuring fluorescence intensity over time, this software allows pixel integration over a user specified area. This data was output to a Microsoft Excel file, and the resulting data was processed using ChromPerfect software (Justice Laboratories, Denville, NJ). For studies where dimensions were measured, the images were analyzed with Q Capture Pro software (QImaging, Montreal, Canada). The images in Figures 1E-F were captured using an upright microscope (Olympus EX 60) equipped with the same Qicam Fast digital CCD camera and Streampix Digital Video Recording software.

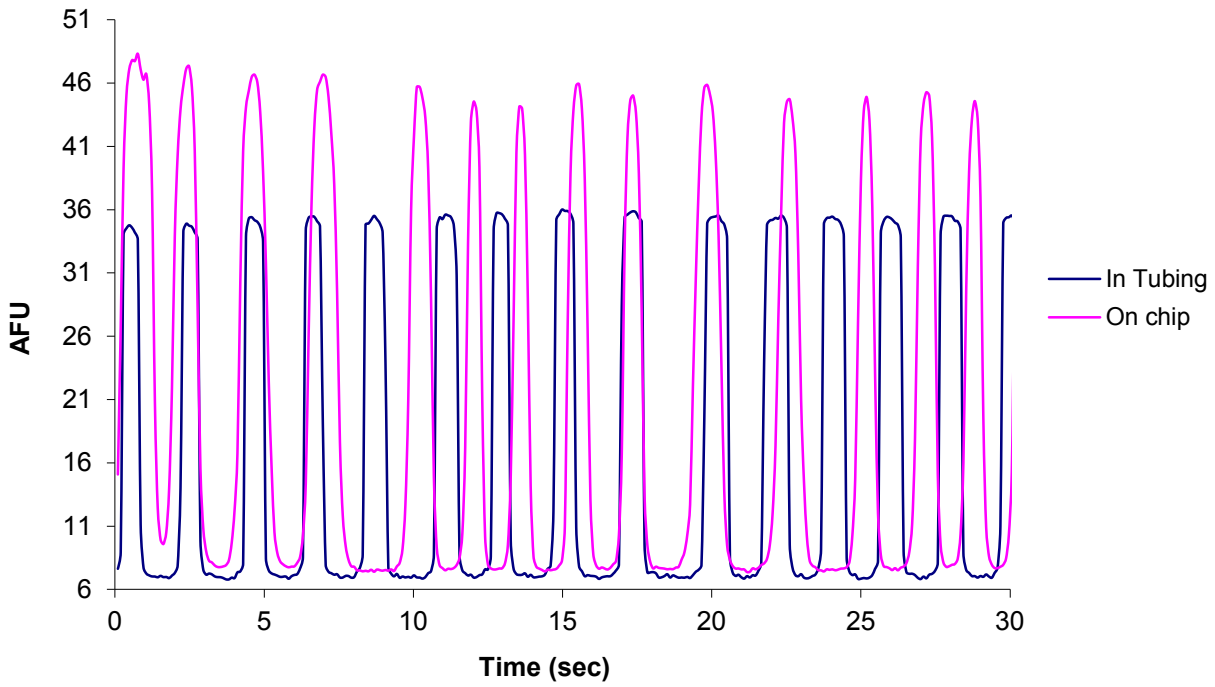

Figure S1. Overlay plot showing frequency of droplets (containing fluorescein) for both in-tubing (150-µm i.d. PFA tubing) and after being transferred on-chip. For a period of 30 sec, 14 droplets were recorded for both the in-tubing and on-chip droplets. This lead to a droplet frequency of 0.467 Hz for each. The frequency-based droplet coalescence, which was calculated by dividing the on-chip droplet frequency by the in-tubing droplet frequency, was found to be 1.0. This matches up well with the volume-based droplet coalescence value of 1.2 (see text for more details), demonstrating that the embedded method results in a very low dead volume interconnect.

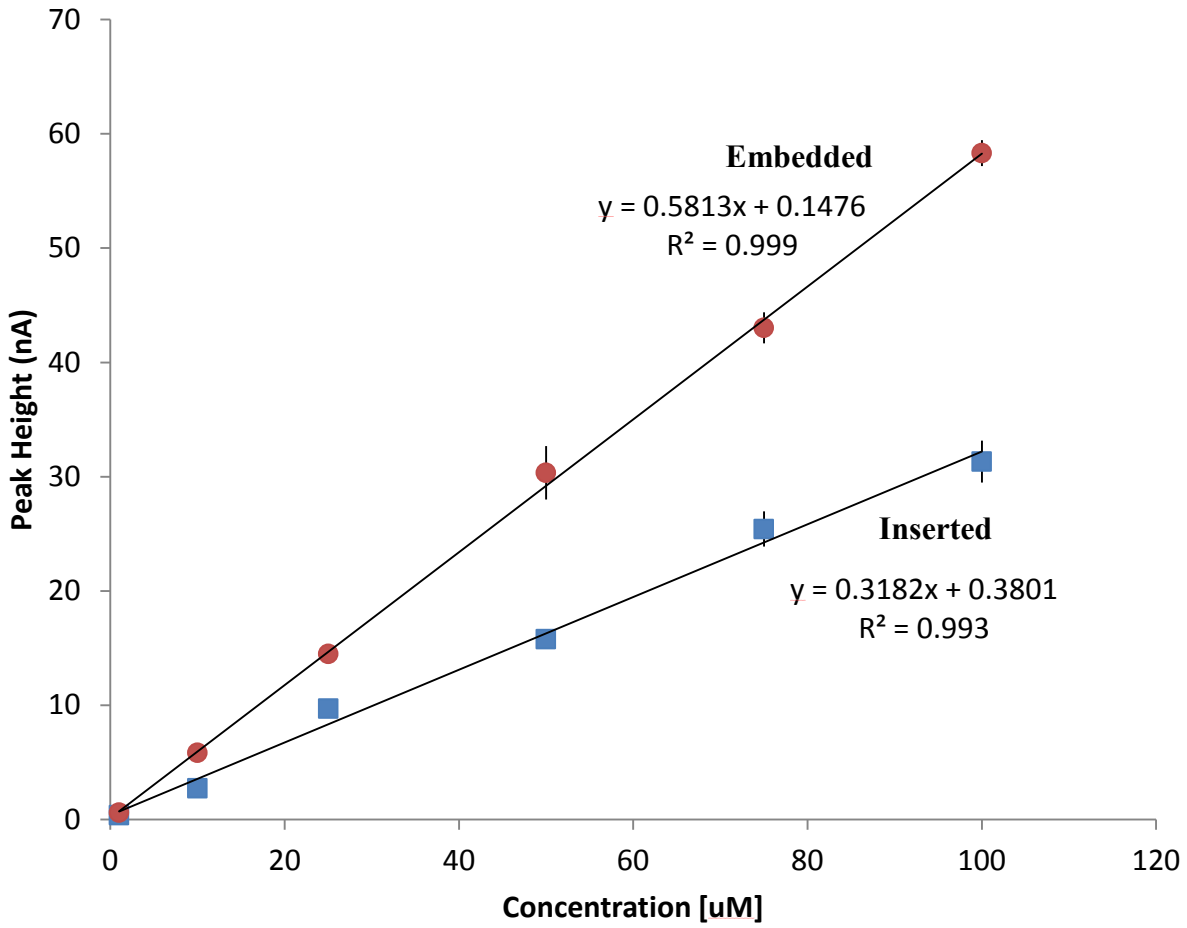

Figure S2. Calibration curve (catechol) comparing sensitivity and linear response for on-capillary injection with an inserted capillary versus on-capillary injection with an embedded capillary. Error bars are expressed as the standard deviation. In both cases a 50-µm i.d. fused silica capillary was used, approximately 25 cm in length.

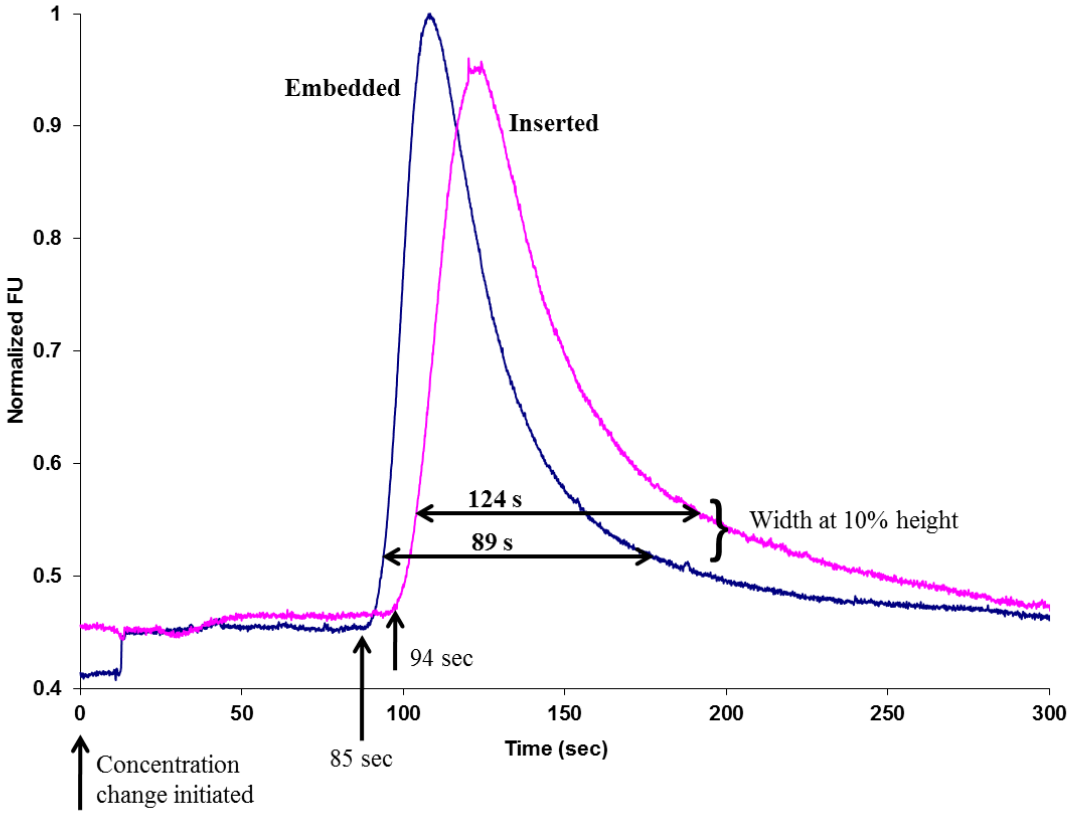

Figure S3. Microdialysis studies comparing inserted versus embedded method for dialysate tubing. The probe was perfused at 0.8 µL/min. To simulate a concentration change, the microdialysis probe was moved from a vial of 1 mM fluorescein to a vial of 5 mM fluorescein for 10 sec. In both cases a 50-µm i.d. fused silica capillary, which was fitted with a 794 µm o.d. microtight sleeve to make the connection with microdialysis probe possible, was utilized. The figure above is for 1 data set. This experiment was repeated 3 times for both the embedded and inserted methods ($n = 3$ for each). The average values are given below.

Embedded: average lag time = 87.7 ± 2.5 sec
average peak width at 10% height = 94.7 ± 5.1 sec

Inserted: average lag time = 93.3 ± 1.2 sec
average peak width at 10% height = 120.7 ± 4.2 sec

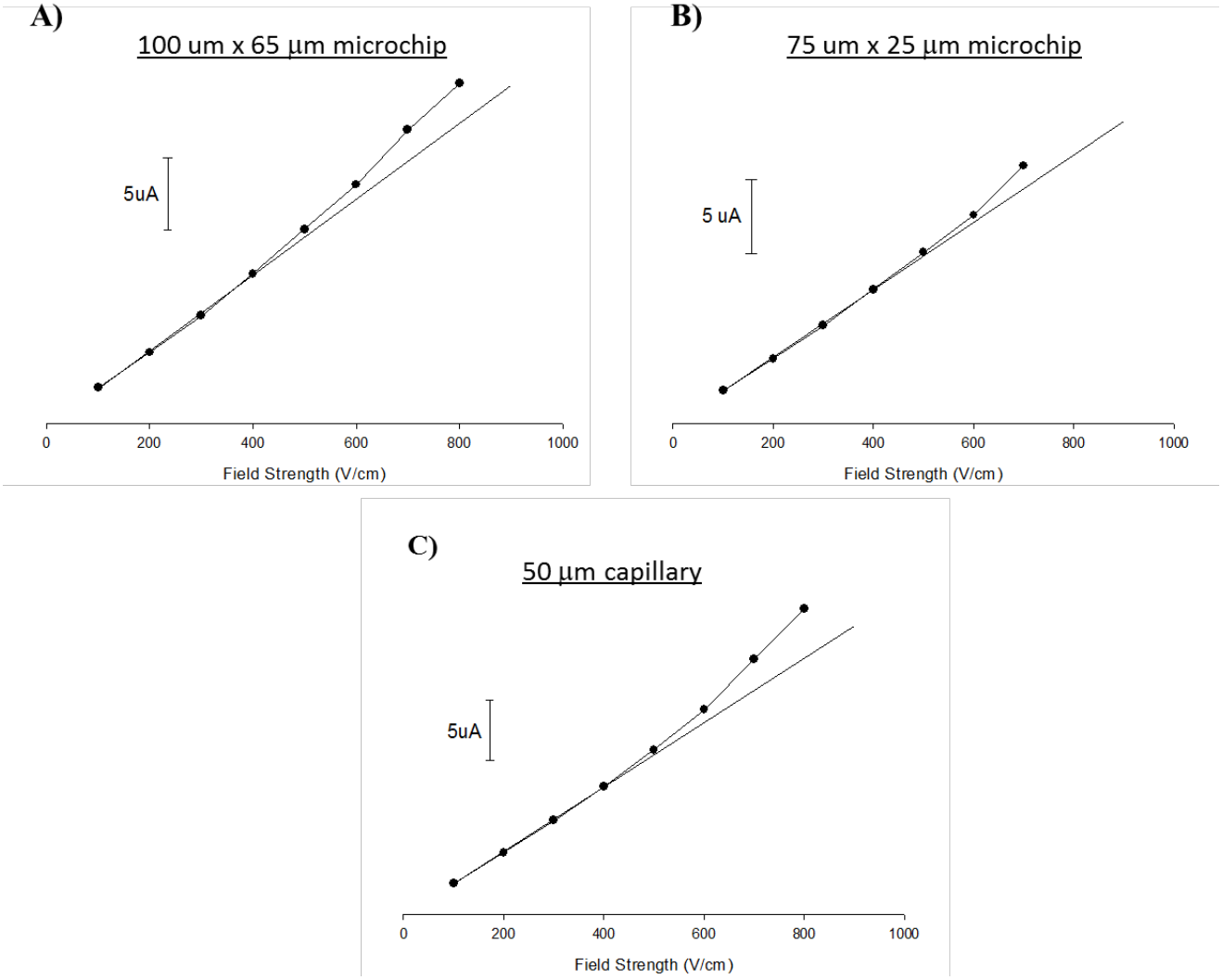

Figure S4. Ohm's law comparison for a 50 µm i.d. capillary interfaced with **A)** a 100 µm (in width) x 65 µm PDMS microchannel grounded with a 1 mm palladium decoupler; **B)** a 75 µm µm (in width) x 25 µm PDMS microchannel grounded with a 1 mm palladium decoupler; and **C)** a buffer vial grounded with a platinum wire (a conventional CE experiment). In each case, a 25 mM boric acid buffer (pH 9.2) was used. A solid line has been added to each plot that shows the expected trend for truly linear behavior. As can be seen the 50 µm capillary and 75 x 25 µm microchannel with palladium decoupler show a similar trend, with non-linearity occurring at values greater than 600 V/cm. This trend can be explained by the cross-sectional area of the 75 x 25 µm microchannel (1875 μm^2) more closely matching the 50 µm capillary (1962.5 μm^2), with the larger channel (6500 μm^2) leading to a higher electrophoretic current.

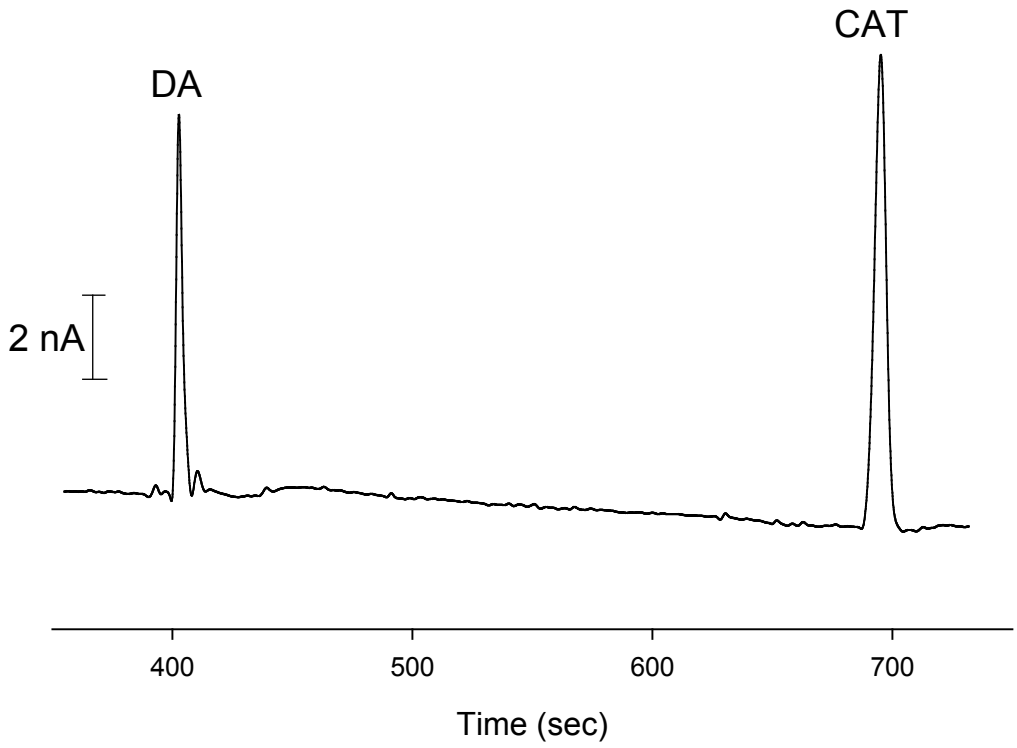

Figure S5. Separation of dopamine (DA) and catechol (CAT) at 200 V/cm across a 50 cm long capillary, with a 0.5 nL injection volume. The analytes had a concentration of 100 µM each and a 25 mM boric acid electrophoresis buffer (pH 9.2) was used. A 75 x 25 µm PDMS microchannel was used to interface the 50 µm i.d. capillary, 2 mm palladium decoupler, and 500 µm platinum detection electrode. The number of theoretical plates (N) for dopamine and catechol were 128,600 and 91,000, respectively.