

Supplementary Materials:

Fluorescein pH tracing tests

The fluorescence emission of Fluorescein is pH dependant. At $\text{pH} < 4$, the fluorescence emission of the dye is quenched. At $\text{pH} > 4.5$, a strong green fluorescence emission is exhibited.^{1,2}

The pH tracing tests were performed by pumping a Fluorescein solution and filling completely a microchannel having the mixer electrodes. Fig. 1(b) shows the initial uniform distribution of fluorescein and light intensity when no voltage is applied. When the mixer is actuated by application of the potentials ($20V_{\text{pp}}$ and $\pm 2V$), control Faradaic reactions take place whereby H^+ ions are produced at the anode (+) and OH^- ions are generated at the cathode (-). Consequently, the fluorescence emission of Fluorescein is lost at the anodic side of the mixer and that area appears dark in Fig. 1(a) and Fig. 1(c).

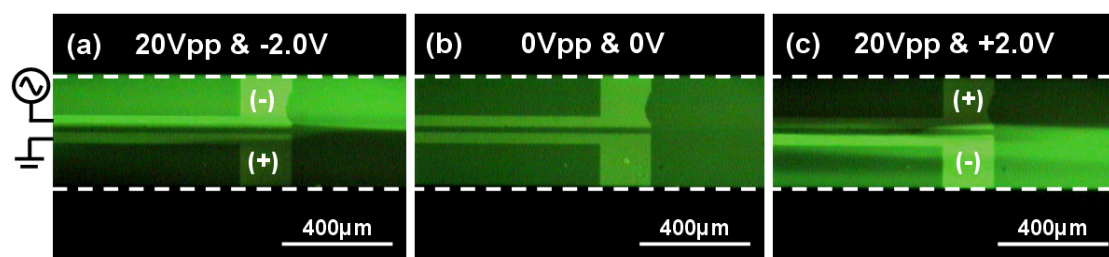


Figure 1: Fluorescein fluorescence emission dependence with application of voltage to the DC-biased ACEK micromixer. (a) Mixer operated at negative DC-bias. (b) Mixer without application of voltage. (c) Mixer operated at positive DC-bias. Other experimental conditions: $f = 500$ kHz, $\sigma = 1\text{mS/m}$ (fluorescein/KCl), $\dot{Q} = 5$ $\mu\text{L}/\text{min}$ (pressure driven flow from left to right) and channel width = $400\mu\text{m}$.

Video 1:

This video shows the helical flow path of $1\mu\text{m}$ beads introduced at 2 $\mu\text{L}/\text{min}$ in a 100 μm wide channel when the DC-biased ACEK micromixer is actuated. The video is captured at 30 frames per second. Experimental conditions: AC voltage = 20 V_{pp} , $f = 100$ kHz, DC-bias = 2.5 V, $\sigma = 1$ mS/m (KCl) and $\dot{Q} = 2$ $\mu\text{L}/\text{min}$ (pressure driven flow is from right to left).

Video 2:

This video shows the mixing process of two laminar streams : a fluorescence dye solution (Bodipy-disulfonate) and an electrolyte (KCl) solution in a 100 μm wide microchannel. The video is captured at 10 frames per second. Experimental conditions: AC voltage = 20 V_{pp} , $f = 500$ kHz, DC-bias = 2.5 V, $\sigma = 1$ mS/m and $\dot{Q} = 2$ $\mu\text{L}/\text{min}$ (pressure driven flow is from left to right).

References:

1. Fluorescein sodium salt (Product No.: F6377), Sigma-Aldrich Product Information, (http://www.sigmaaldrich.com/sigma-aldrich/product_information_sheet/f6377pis.pdf)
2. " Fluorescent Indicators", pp. 8-18, in *CRC Handbook of Chemistry and Physics*, 88th Edition (*Internet Version 2008*), David R. Lide, ed., CRC Press/Taylor and Francis, Boca Raton, FL.