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Supplementary information



S1 Microfluidic design and contact points for electrical connections

FIG. S1 CAD file used for the fabrication of the microfluidic system, with indications of the different components. The r = 22.0, 20.5 & 19.5 mm indicates the radial distance from the disc center to the position of the capillary burst valves, and the width of the capillary valves was 1.0, 0.5 & 0.3 mm respectively. The first capillary burst valve to burst would be the one furthest from the center (22 mm), which was also the widest (1 mm), on so forth. Red circles in the center indicate contact points for the thin film electrodes and the spring pins on the custom made plug, see Fig. 1 iv. Only 3 of the total number of 12 electrode sets on the disc were in use for this design, one for each microfluidic system. All 12 (in this case, 3) counter electrodes (CE) are connected to the center point. The reference (RE) and working (WE) electrodes can be contacted individually by simply turning the swivel holder in 30 degrees intervals (120 degrees in this case) during the assembly.

S2 Quantification of noise and estimate of limit of detection



FIG. S2 Comparing noise levels between stationary (red line) and rotating (blue line) modes. The noise is isolated from an amperometric measurement of PBS (blank/supporting electrolyte), at -200 mV vs. the on-disc gold reference electrode. Stipulated lines indicates ±1 standard deviation. For the stationary mode (red) 1 SD corresponds to 5.9 pA, and increases to 24.9 pA when the disc is rotating (blue).



FIG. S3 Experimental study of the burst frequency of the capillary burst valves (n=6) compared with theoretically calculated values. The theoretical model is based on balancing capillary pressures with centrifugally induced pressure (see references in main text).



FIG. S4 Plotting the standard deviation of the grey scale image (in the highlighted area) shows how the uniformity changes during the 3 additions. The plot can therefore also tell how the mixing is progressing over time. As can be seen, the standard deviation is very high just when the second liquid is added, but quickly decreases and reaches a stable read-out within approximately 20 seconds. As a comparison the amperometric signal of the ferricyanide mixing with PBS (FIG 5b) was monitored for 100s, suggesting that the mixing has reached a stationary state long before this time frame, and should not be affecting the measurement.



FIG. S5 Picture series made with blue & red colored water to demonstrate the mixing mechanism. Yellow arrows indicate bursting of the 3 capillary burst valves.



FIG. S6 Picture series showing the three different situations used for calculating the mixing percentage (ink/water %). The image area used for the calculation is shown with the red dashed rectangle. The calculation was made as a two point calibration, using the reference as 100% and ink as 0%: (Ref-Mix)/(Ref-ink). A two-point calibration is justified by tuning the concentration of "100% ink" to lie at the edge of the linear response, see FIG. S7



FIG. S7 The concentration of the ink was optimized to be as high as possible, while still responding linearly in the image analysis when diluted during the mixing. Based on this plot the black ink used for the optical experiments was diluted 50% before being introduced to the discs.