Electrochemical velocimetry on centrifugal microfluidic platforms

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Supplementary information

Details of theoretically calculated flow rates

The volumetric flow rate , Q, in a radially-oriented channel on a rotating microfluidic disc was originally defined by Duffy et al.[25] and is given as follows:

$$Q = \frac{A d_H{}^2 \rho \omega r_{avg} \Delta r}{32 \eta L} \qquad \textit{Eq.1}$$

where A is the cross-sectional area of the channel, d_h is the hydraulic diameter of the channel, ρ is the density of the liquid, ω is angular velocity, η is the viscosity of the liquid, L is the length of the channel, Δr is the radial net distance of the of the fluid from the center of the disc, and r_{avg} is the average distance of the liquid to the center. More specifically, r_{avg} and Δr are defined as:

$$r_{avg} = \frac{r_1 + (r_o - H)}{2} \qquad \textit{Eq.2}$$

and

$$\Delta r = r_1 - (r_o - H) \qquad \textit{Eq.3}$$

where r_o is the inner radius of the fluid, r_1 is the outer radius of the liquid, and H is the liquid head length above the channel. While Eq. 1 was originally described for a radially-orientated channel, the channel in our disc design is largely circumferentially-orientated (Fig S2). It was assumed that the serpentine channel dominates the hydraulic resistance of the channel connecting the Loading Chamber to the Collection Chamber and therefore the liquid head was measured to be 11.73 mm. The total length of the serpentine channel was measured to be 37 mm. The hydraulic diameter of the serpentine channel was calculated by 4A/P, where A is the cross-sectional area and P is the perimeter, and was measured to be 0.3 mm. The values for r_{avg} and Δr were calculated to be 28.79 mm and 9.59 mm, respectively. Lastly, the viscosity and density of the liquid (water) were assumed to be 0.001 kg/(s·m) and 1,000 kg/m^3, respectively.

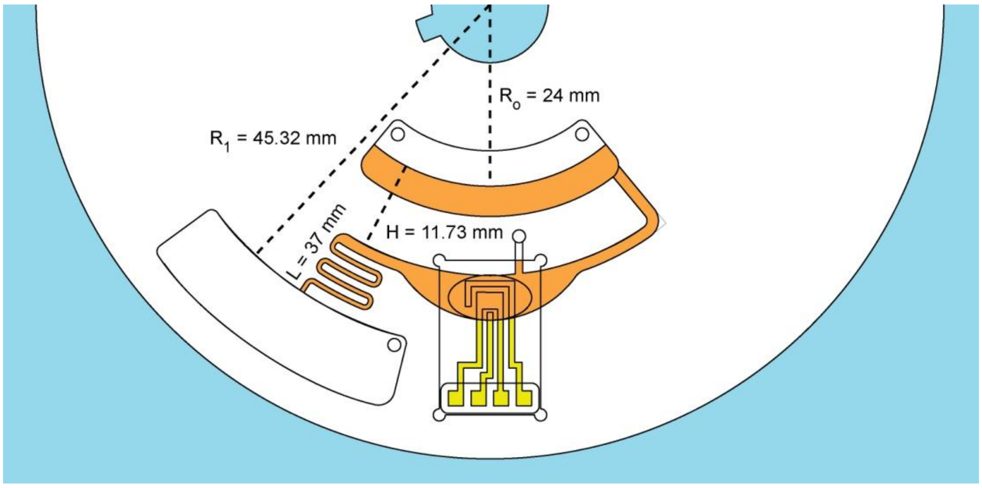

Fig. S2 Schematic detailing the dimensions of the microfluidic design used for theoretical estimations.