Supplementary information

1. Input current for the theoretical model of CDI on chip

The CDI cell is charged through the application of a potential of 0.5 V starting at t = 1.6 min. using a potentiostat (Bio-Logic SP-300, Claix, France) . While charging, the current (I[A]) is measured as a function of time, see figure 1. The current through a single element I_n [A] is obtained by dividing the total current through the number of elements in the CDI cell (n_e).

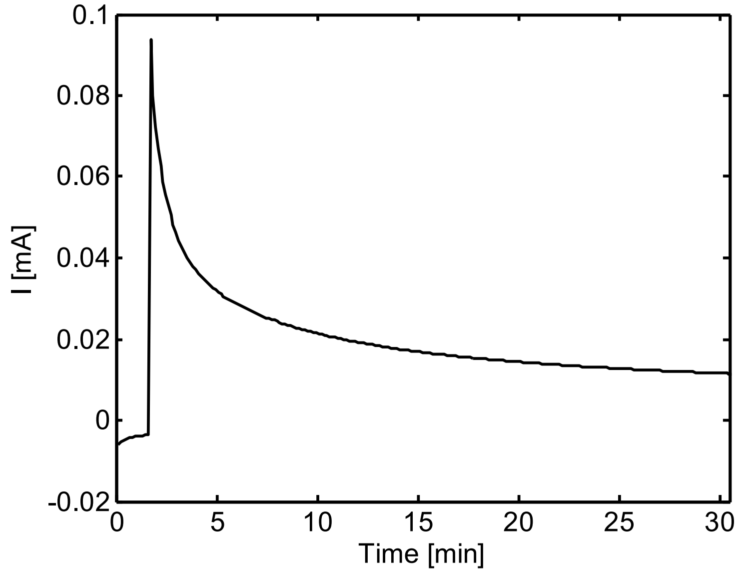

Figure S1: Measurement of the charging current through the capacitor. Starting at t = 1.6 min a potential of 0.5 V is applied.

2. Theoretical model of CDI on chip

The average salt concentration measured with the desalination electrodes can be calculated from the local concentration as function of time. The fluid flowing through the capacitor is divided in n elements, see figure 2.

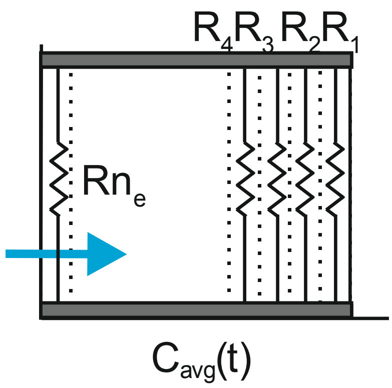

Figure S2: Schematic of the CDI cell with a 10 mM NaCl solution entering from the left. A number of n_e elements fit in the cell. Each element has a salt concentration varying over time which is directly related to the resistance *of the element. The impedance measurements with the desalination electrodes return the summation of all these elements.*

Between the desalination electrodes n_e elements are situated at the time of a single measurement. Each element contains a certain molarity of salt depending on the amount of desalination. The salt concentration is related to the conductivity σ[S m^{-1}] and the resistivity (ρ[Ωm]) ,which is given by ρ = 1/σ. The resistance $R(t_n)$[Ω] of a single element is obtained through $R(t_n) = \rho K_{cell}$, where K_{cell} is the cell constant of an element given by d/a. d = the width of the channel and a is the area of the electrodes. The total resistance (R_t) as it is determined with the impedance electrodes is calculated by adding the resistances R_1 to R_{ne} in parallel using equation 1 and 2.

$$\frac{1}{R_t} = \sum_{1}^{n} \frac{1}{R_{tn}} \quad ,\text{for } n < ne \qquad 1)$$

$$\frac{1}{R_t} = \sum_{n-ne}^{n} \frac{1}{R_{tn}} \quad ,\text{for } n \geq ne \qquad 2)$$

3. Fluorescence images of FITC-dextran

Fluorescence microscopy is used to monitor the concentration of FITC-dextran over time. Images were taken at the exit of the CDI electrodes. An example of a fluorescent image is shown in figure 3. The green line indicates the location between the CDI electrodes where the fluorescence intensity was measured over time.

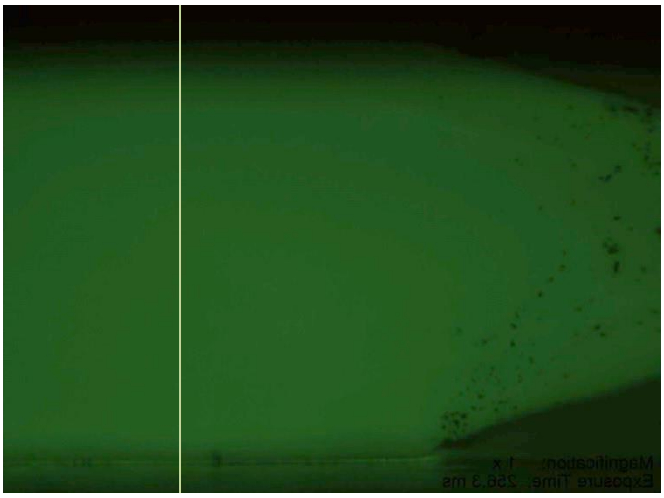

Figure s3: Example of a fluorescence microscopy figure from the exit of the microfluidic channel.