Electronic Supplementary Material (ESI) for Lab on a Chip.

Electronic Supplementary Information

A chip device to determine surface charge properties of confluent cell monolayers by measuring streaming potential

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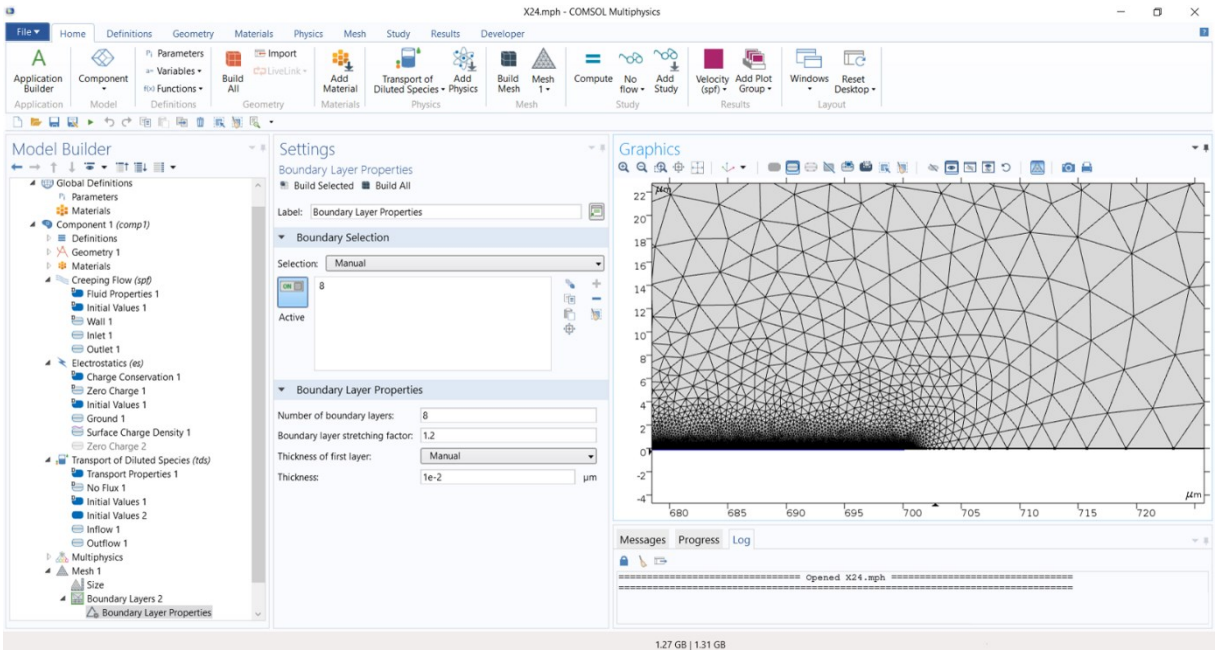
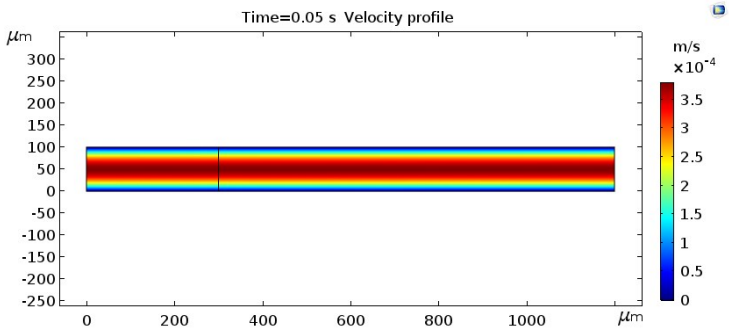
Section I. Simulation



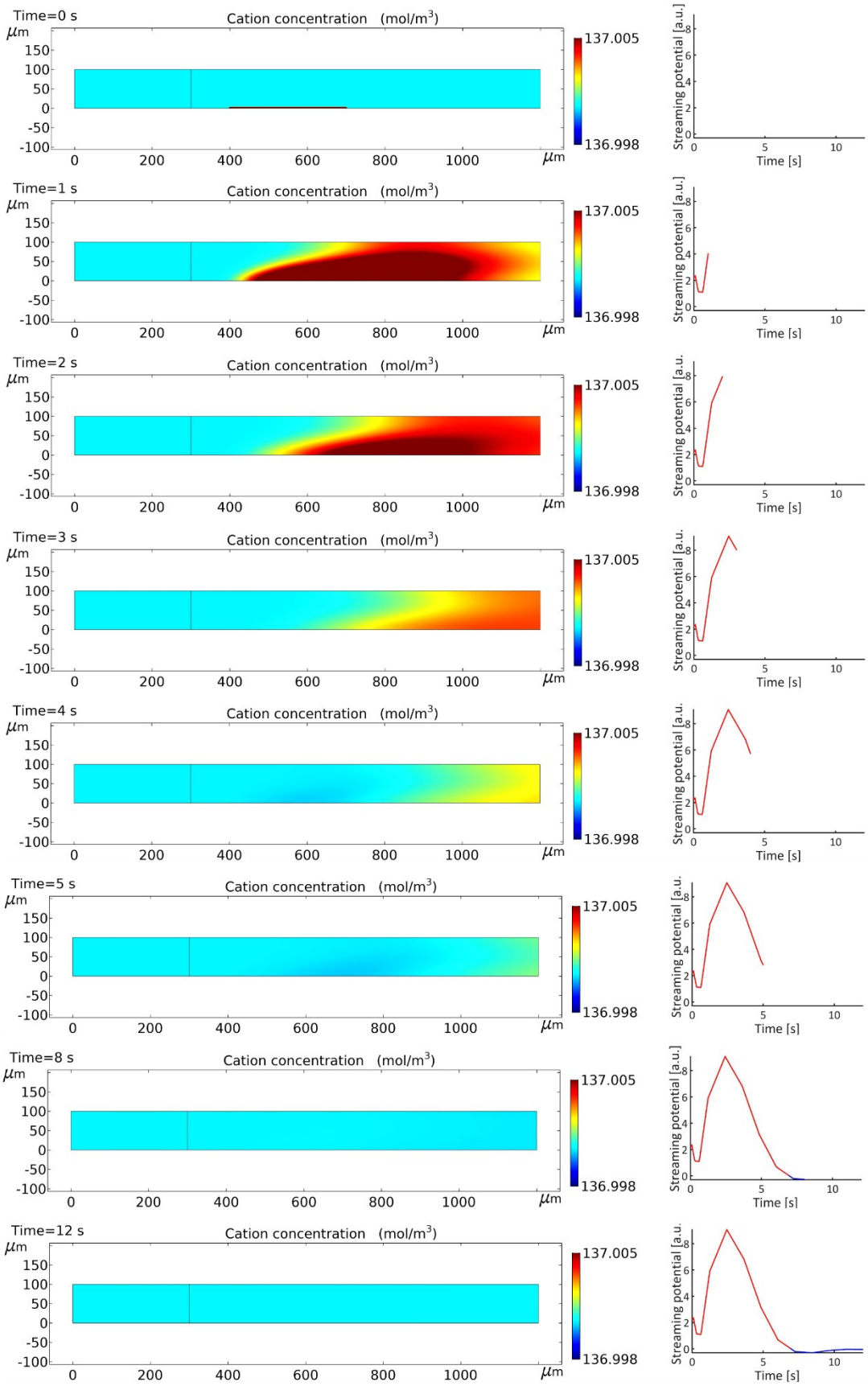
ESI Figure S1 *Three of the Multiphysics platforms of COMSOL were used for the simulations: Creeping Flow (spf), Electrostatics (es) and Transport of Diluted Species (tds). Between them, the following coupling modes were introduced: Potential Coupling (pc1), Space Charge Density Coupling (sdc1) and Flow Coupling (fc1). The simulation was performed in a 2D (a semi-3D) environment. The geometry of the model system (the channel) was a straight pipe with parallel walls. At the bottom of the channel, a partial section was the charged surface with a known zeta-potential (the highest density of mesh points). There is a trade-off between the number of mesh-points (that still can be handled by the computer) and the resolution of the mesh that influences heavily the convergence of the iterations.*



ESI Figure S2 *Velocity profile in the longitudinal section of the channel under laminar flow conditions. A laminar inflow condition was set at the inlet in the Creeping Flow module, too, so the steady state was developed during the very first time steps. The vertical line at 300 μm shows the position of the reference electrode, while the measuring electrode was positioned at the outlet surface (right end of the channel).*

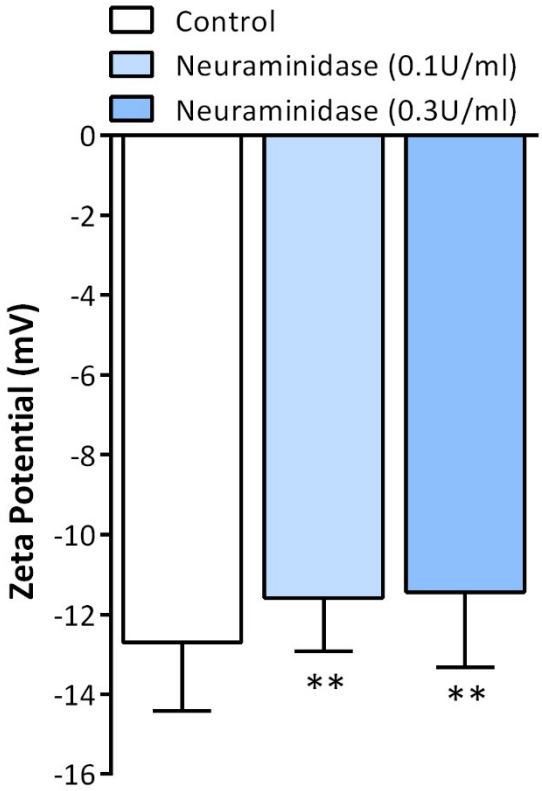
To model the dependence of the streaming potential on zeta potential, a parametric sweep of the zeta potential at the charged surface section was applied.

A movie demonstrating changes of the cation concentration profile in the longitudinal section of the channel, and simultaneously showing the simulated electric potential at the outlet is presented in ESI Video V2. Snapshots of this movie at selected time points are depicted in ESI Figure S3.

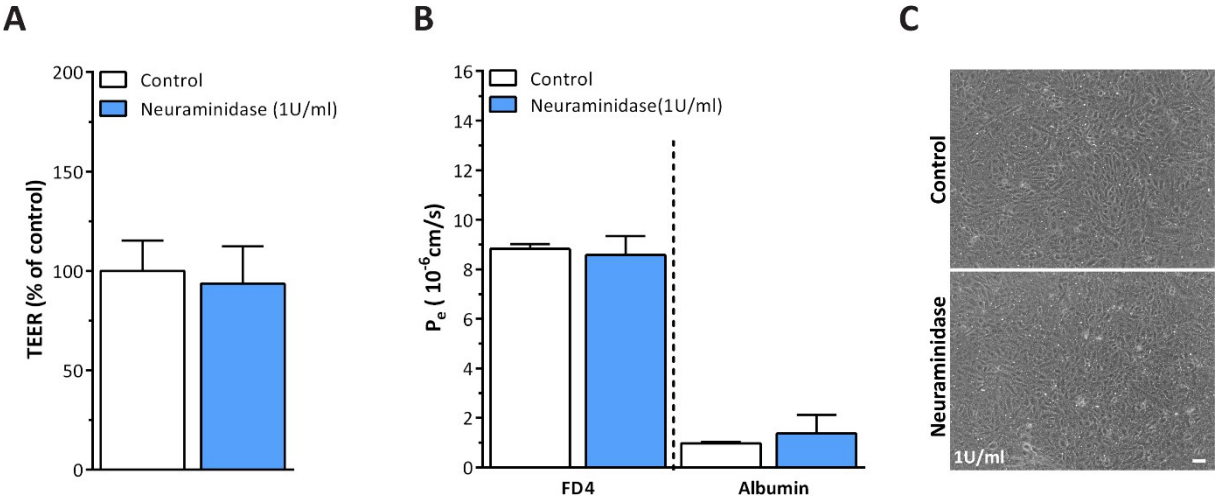


ESI Figure S3 *Simulated movement of the counterion cloud under creeping flow, and the time evolution of potential difference between the measuring and reference electrodes. Note that the vertical line at 300 μm represents the reference electrode.*

Section II. Additional experiments on brain endothelial cells cultured on inserts: neuraminidase treatments at lower concentrations and barrier measurements



ESI Figure S4 *The effect of neuraminidase concentrations (0.1 and 0.3 U/ml) on hCMEC/D3 human brain endothelial cells. Effect of different concentrations of neuraminidase on the surface charge of cells measured by laser-Doppler velocimetry. Values of each group are presented as mean ± SD, n=30-66. Data were analysed by one-way ANOVA followed by Bonferroni post-test. **, p < 0.01 compared to the control group.*



ESI Figure S5 *Evaluation of the paracellular barrier integrity of confluent hCMEC/D3 human brain endothelial cell layers cultured on insert after neuraminidase treatment (1U/ml). (A) Transendothelial electrical resistance (TEER) measurements after 1h neuraminidase treatment. Values of each group are presented as mean ± SD, n=3. Data were analysed by unpaired t-test, no statistically significant difference was found. (B) Endothelial permeability coefficient (P_e) of cells treated with neuraminidase for two paracellular hydrophilic tracers, 4 kDa FITC-dextran (FD4) and albumin. Values are presented as means ± SD, n=3. Data were analysed by unpaired t-test, no statistically significant difference was observed. (C) Phase contrast pictures of hCMEC/D3 cells after neuraminidase treatment, bar: 20 µm. No morphological change is visible.*