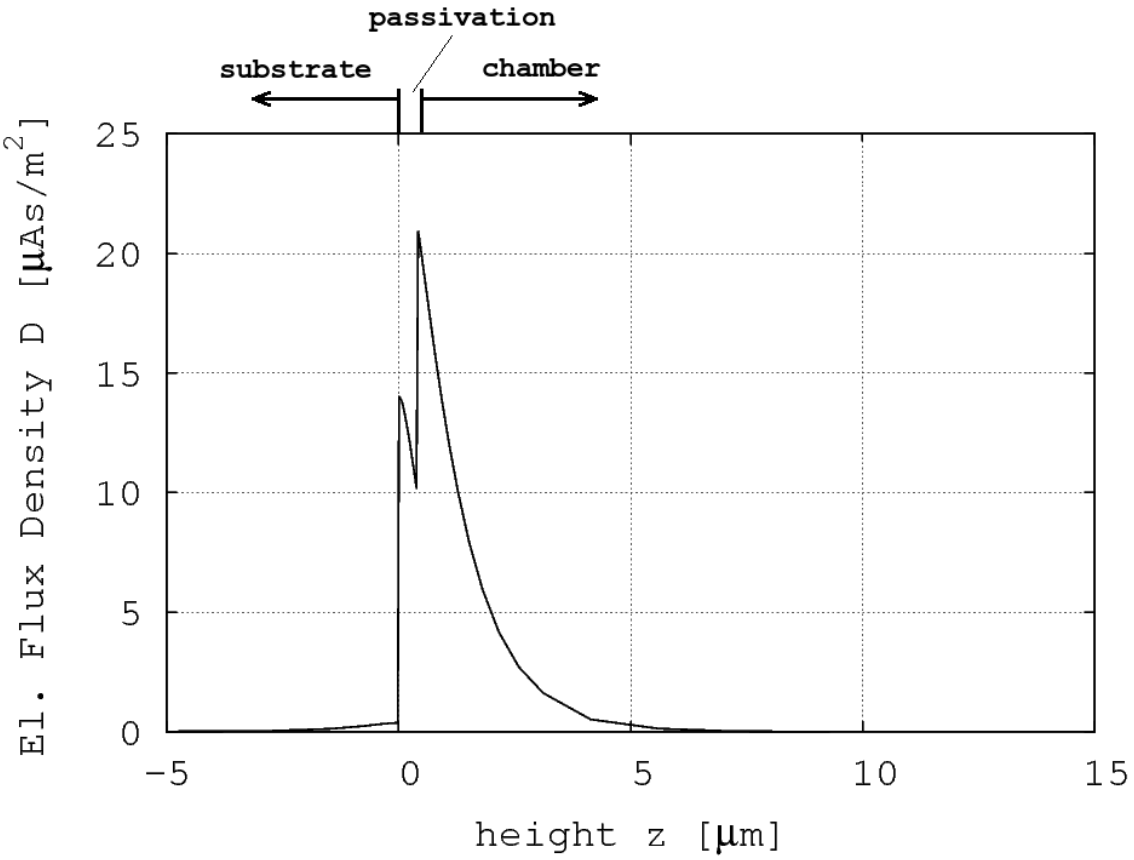
Supplementary Table 1

Capacitance at 2000 Hz	Air filled chamber	DI water filled chamber	Absence of passivation, air filled chamber
$C_{experimental}$ *[pF]*	8.4	29.9	5.6
$C_{numerical}$ *[pF]*	8.1	28.6	5.8

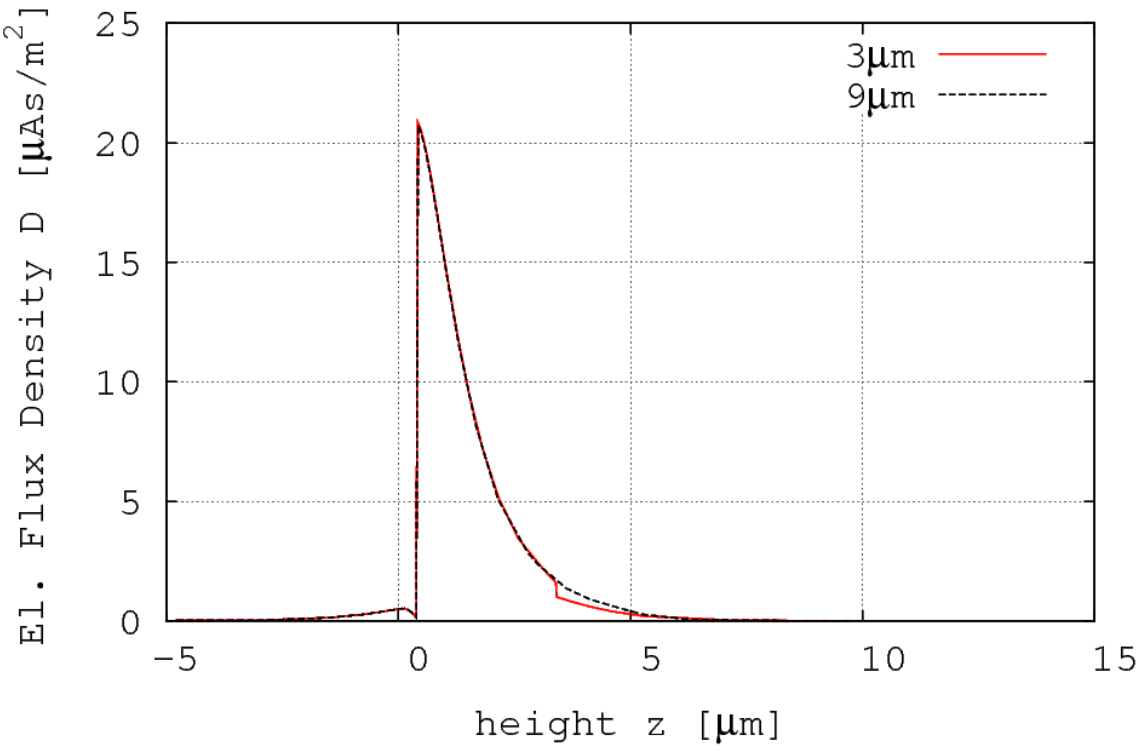
Comparison between experimental and numerical data.

Suppl. Figure 1



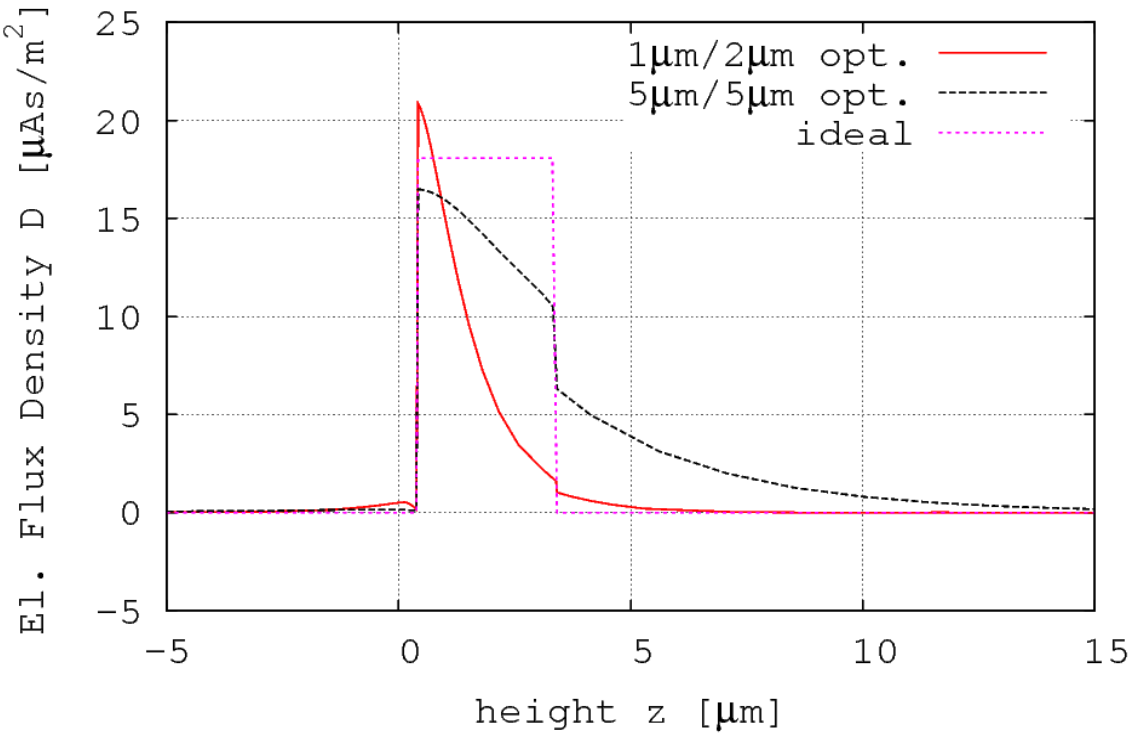
Dielectric flux density in x-direction D_x for a lab-on-a-chip with a homogeneous passivation layer, a finger width of 1 µm and a finger distance of 2 µm along a line which is parallel to the z-axis and placed in the center of the µIDC at an equal distance to the positive and the negative electrodes (inlet). The chamber of the chip is filled with destilled water.

Suppl. Figure 2



Dielectric flux density in x-direction D_x for a lab-on-a-chip with a finger width of 1 µm and a finger distance of 2 µm along a line which is parallel to the z-axis and placed in the center of the µIDC at an equal distance to the positive and the negative electrodes. Suppl Figure 2 illustrates D_x of a lab-on-a-chip with optimized passivation layer for a 3 µm and 9 µm high cell layer with a relative permittivity of 150.

Suppl. Figure 3



Suppl. Figure 3 compares the electric flux density in x-direction D_x for two different finger dimensions: a) finger width of 1 µm and finger distance of 2 µm and b) finger width of 5 µm and finger distance of 5 µm. The figure clearly shows that the maximum dielectric flux density is obtained for the µIDC with 1µm/2µm structure. However, the dielectric flux D_x of the 1µm/2µm sensor decreases more strongly with increasing distance from the electrodes than the dielectric flux D_x in the 5µm/5µm finger structure. The three simulated curves show the distinctive step at the cell-water interface caused by the differing values of the permittivity in the cell and in the water region. Suppl. Figure 3 also illustrates the ideal electric flux density inside the lab-on-a-chip devices, which should be zero in all regions expect in the cell layer (object to be measured), where a constant dielectric flux would be beneficial.