Supporting Information

Discrete electrostatic charge transfer by the electrophoresis of a charged droplet in a dielectric liquid

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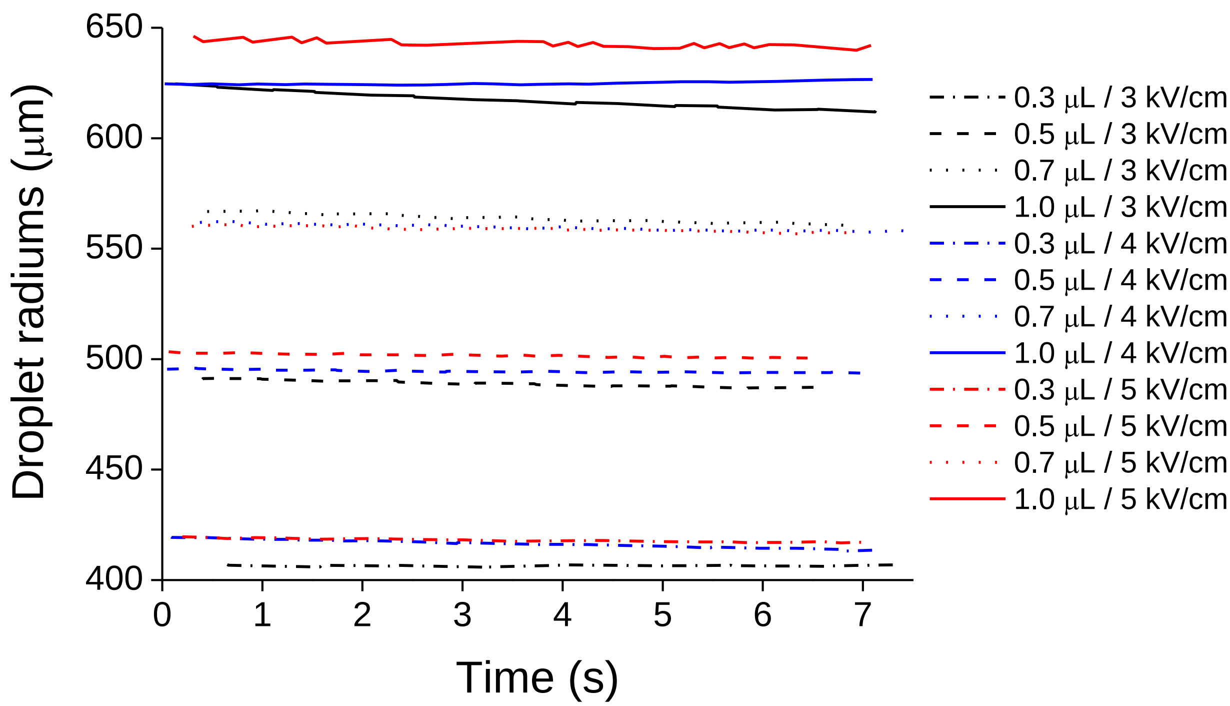

Figure S-1. The droplet volume change during the experiment. The droplet radius at the center where droplet velocities were measured is plotted for each experimental condition. The relative droplet radius change ranges from –0.33% (0.3 μL / 4 kV/cm) to +0.05% (1.0 μL / 4 kV/cm). Even though some of data show decreasing trend with respect to time, there is also the case when the radius does not change (0.3 μL / 3 kV/cm) and even increases (1.0 μL / 4 kV/cm). Therefore, the change of droplet radius is supposed to be attributed to the errors from image rather than an actual volume change (if the test cell was slightly inclined, the size of the image could change).

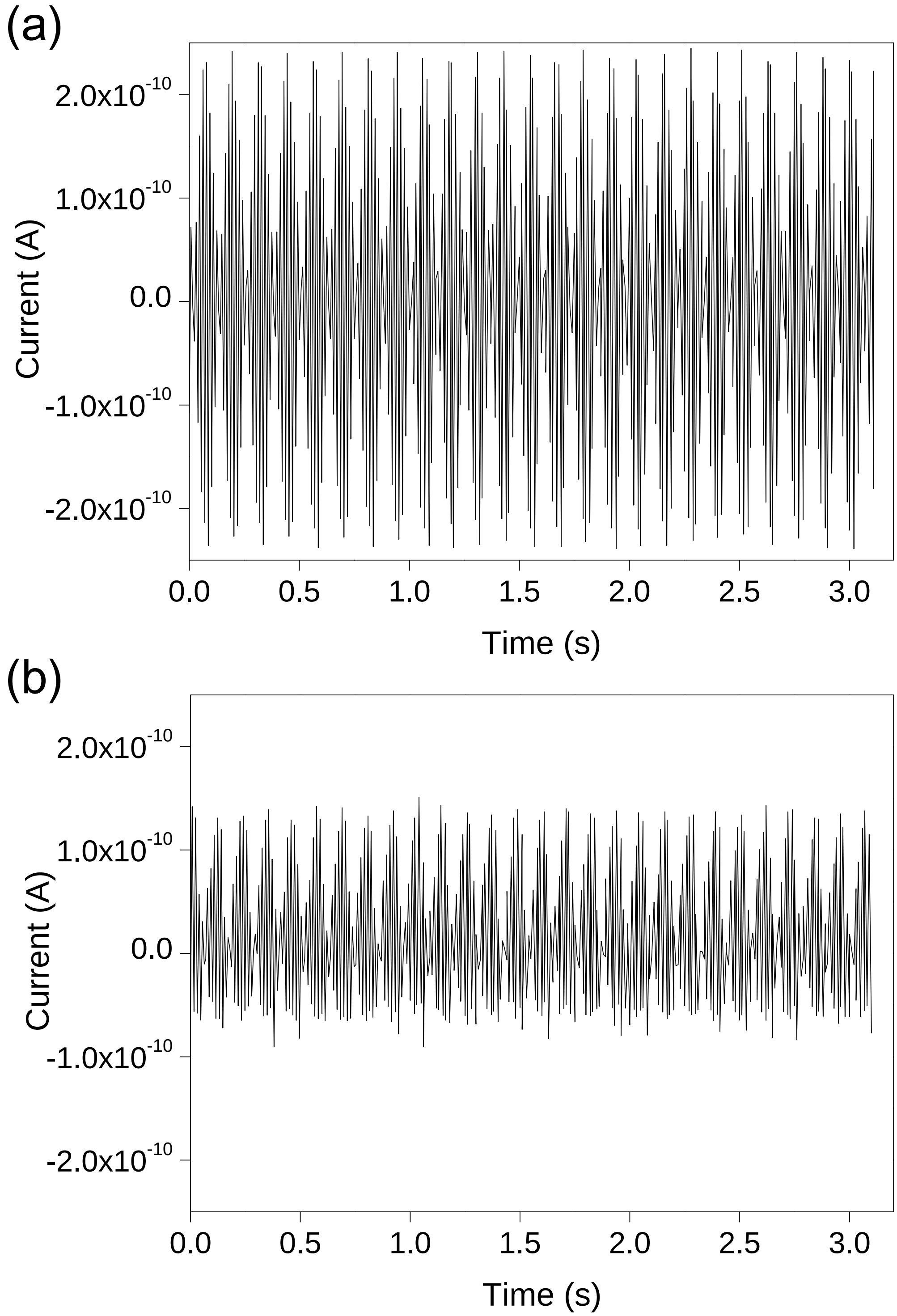

Figure S-2. The current signals through the silicone oil without any droplet (a) under 0 kV/cm (noise signals) and (b) under 5 kV/cm. The average current is -2.1×10^{-13} A for 0 kV/cm (noise signals) and 1.7×10^{-11} A for 5 kV/cm.

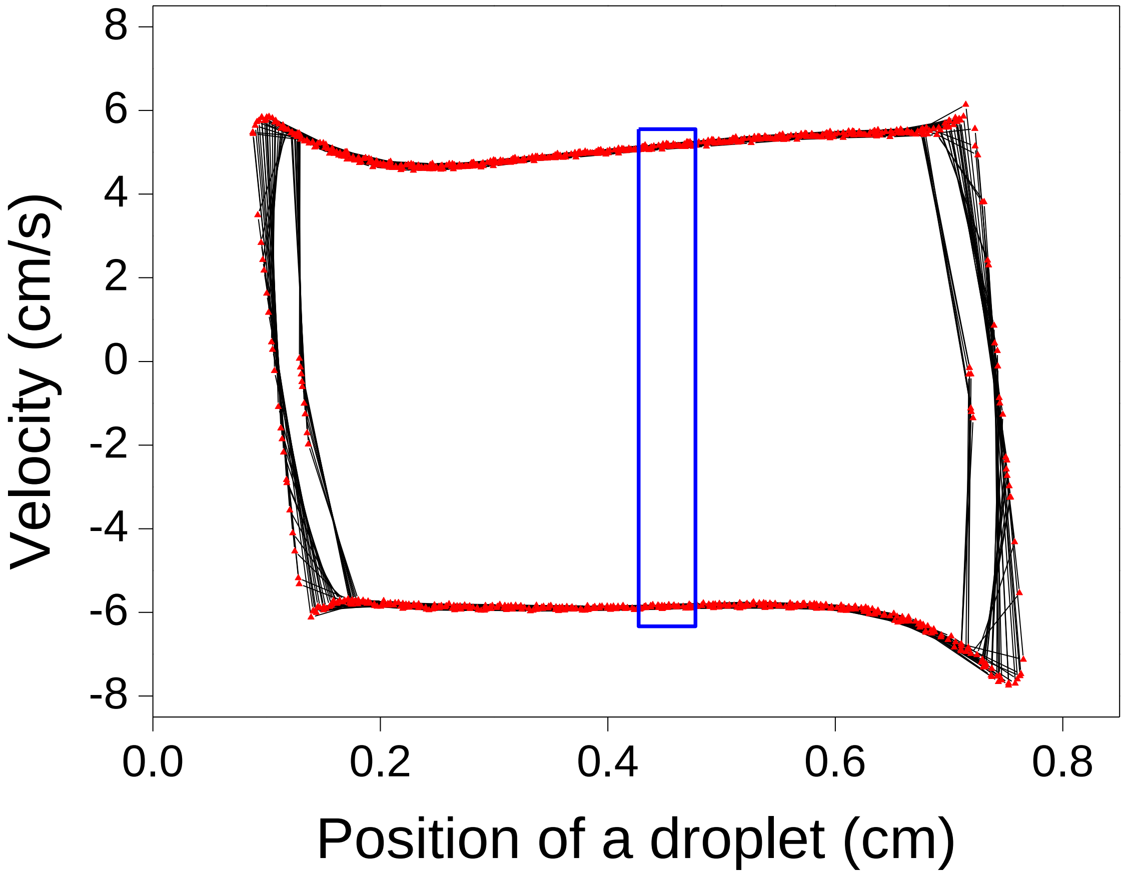

Figure S-3. The velocity of a droplet as a function of the position of the droplet. The velocity distribution of the negatively charged droplet (upper positive velocity) is similar to that of the positively charged droplet (lower negative velocity). The charge of a droplet is estimated from the velocities at the center (blue rectangle).

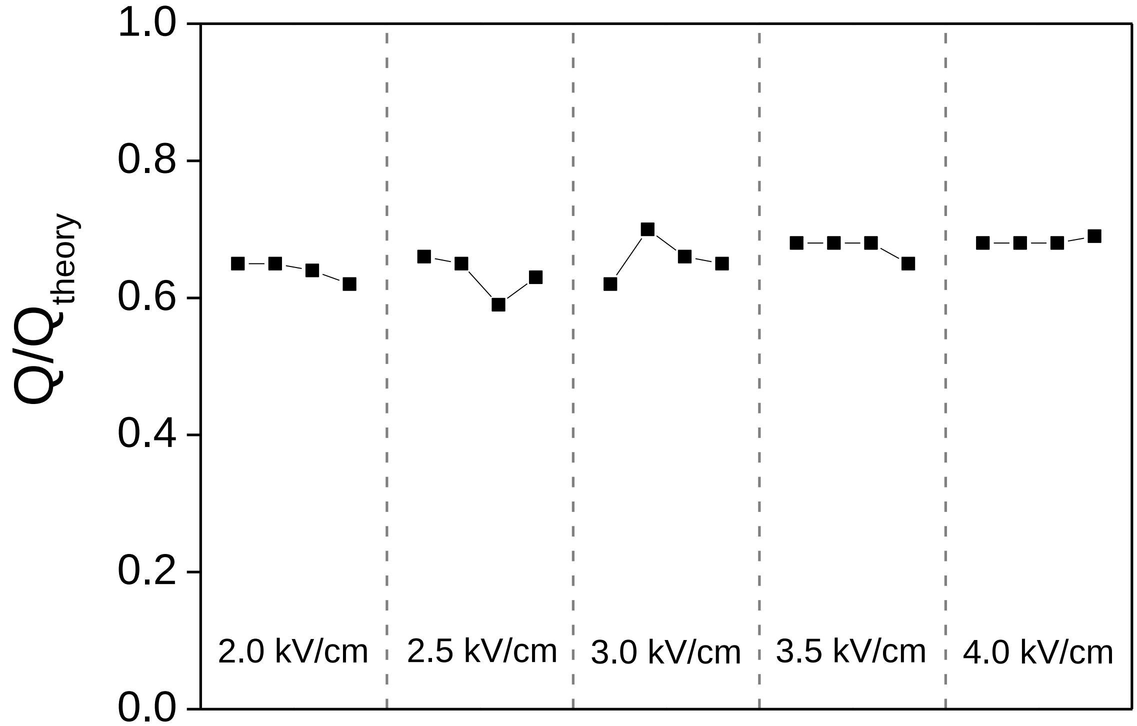

Figure S-4. The dimensionless charge of small droplets under moderate electric field. Each column represents a different electric field, and within each column, the droplet radius increases from left to right (the droplet volume is 50, 100, 200, and 400 nL, respectively). We used smaller droplets under relatively low electric field to exclude deformation effects on charging by minimizing the deformation of a droplet. Most dimensionless charges are around 68% of that of the corresponding perfect conductor when the Hadamard-Rybczynski law is applied for the drag force.

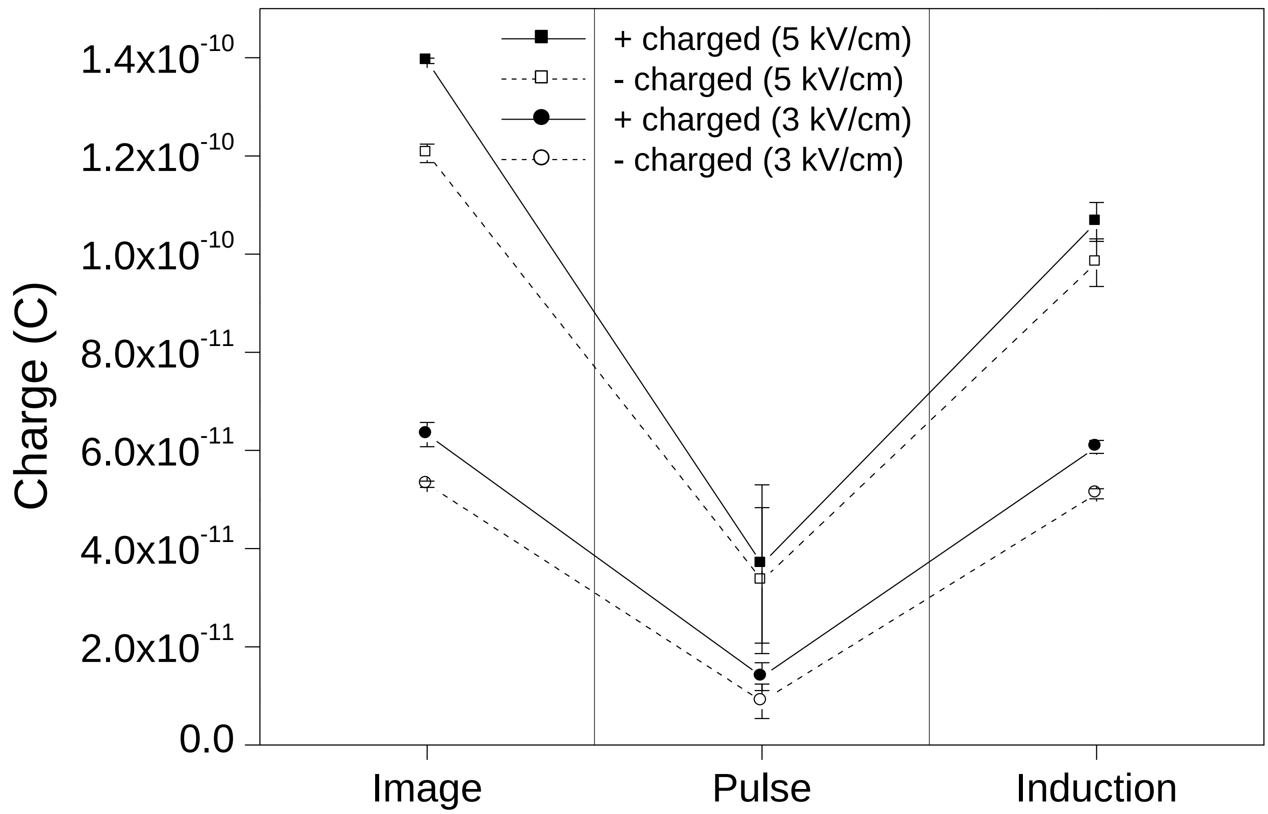

Figure S-5. Comparison of the data from different charge measurements of a 1.0 μL water droplet. The Stokes law is used for the estimation of charge in the image analysis. The charge of a positively charged droplet is (1.39 ± 0.005) x 10^{-10} C for image and (1.07 ± 0.04) x 10^{-10} C for induction under 5 kV/cm and (6.33± 0.025) x 10^{-11} C for image and (6.07 ± 0.013) x 10^{-11} C for induction under 3 kV/cm, respectively.

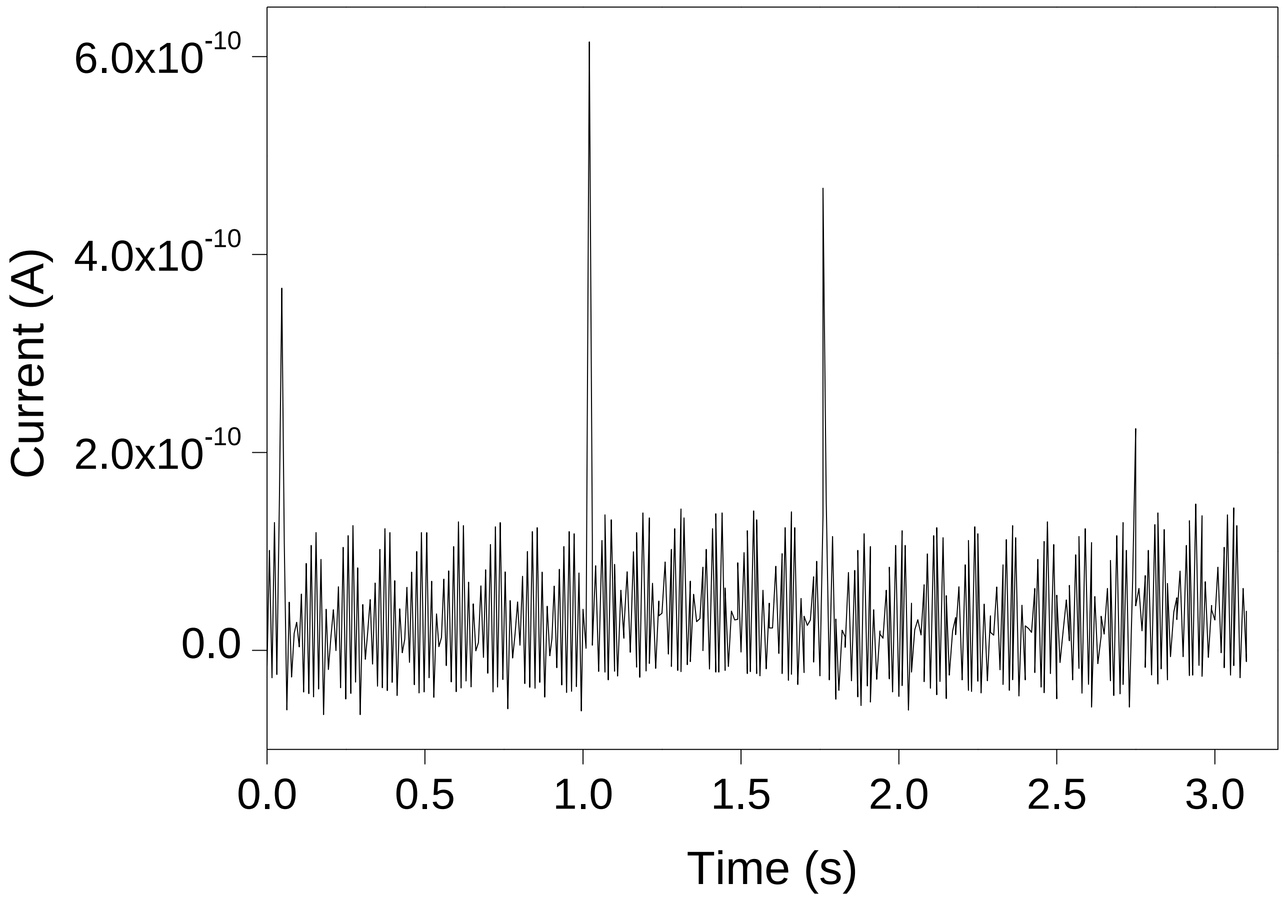

Figure S-6. The electrometer signal for a 300 nL droplet under 3 kV/cm. For electric fields lower than 3 kV/cm, it is difficult to get the pulse type signals which are necessary to distinguish each induction signal between pulses.