ELECTRONIC SUPPLEMENTARY INFORMATION FOR

Continuous-flow electrorotation (cROT): an improved throughput characterization for dielectric properties of cancer cells

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Details of numerical simulation

Finite element simulations of electric field were performed using COMSOL Multiphysics® (v6.0). Figure S1 shows a calculation model used in these simulations. The calculation domain is set as 160 µm × 160 µm × 50 µm (width (x) × depth (y) × height (z)). In Fig. S1, the origin of the coordinate (O) is in the middle of the electrodes on the bottom plane. The material of the domain is used working medium (conductivity: 0.038 S/m, permittivity: 80). In the simulation shown in Fig. 4, the electrode gap and channel height (red values in Fig. S1) were changed as variable parameters (30–50 µm) to investigate the relationship between the electrode gap and the magnitude of the electric field.

In the electric field simulations, we used the Electrostatics interface in AC/DC module in COMSOL. It solves Gauss' law as a governing equation. The boundary condition at the electrode area was set electric potential at the voltage of ROT or DEP and that at the other area was zero-charge.

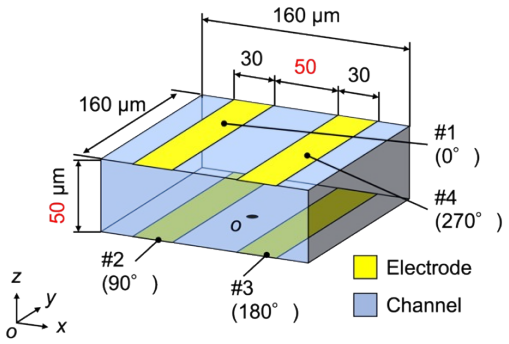

Fig. S1 Schematic of calculation domain for electric field simulation.

Experimental system

As in Fig. S2, bright-field observations were used to analyze the rotational behavior of the cells in cROT device. A LEF light was irradiated from above, and the cell images were recorded from below. To infuse the cells, a syringe pump was used at a constant flow rate. The four output signals from a function generator was connected to the electrode of the cROT device. Each waveform of the signal was programmed by a waveform creation software. Using these systems, successive images of rotating cells were acquired and analyzed to determine the angular velocity by image processing.

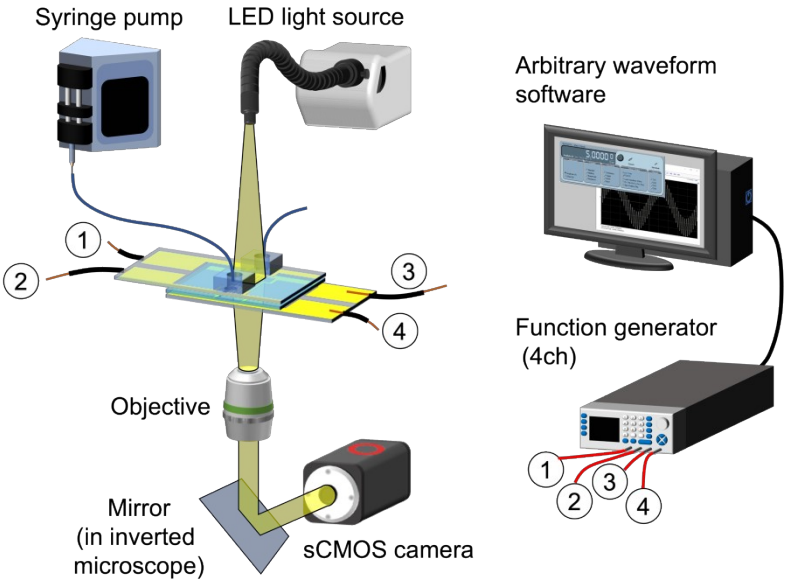

Fig. S1 Schematic of setup for cROT experiment.

Video S1:

Movie of the cells rotating vertically between the electrodes of the device shown in Fig. 2.

Video S2:

Movie of the rotational behavior of a cell and the similarity obtained by image processing.

Video S3:

Movie of the flowing cells with a rotational motion by ROT. The device shown in Fig. 2 is used with a syringe pump.