

## Electronic Supplementary Information (ESI)

### Electroactive microwell array device to realize simultaneous trapping of single cancer cells and clusters

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### Supplementary Figures

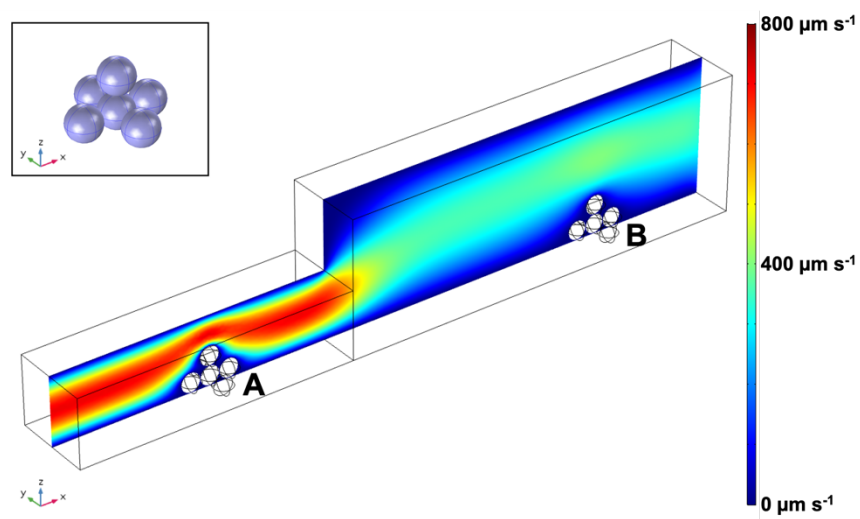


Fig. S1 Numerical simulation of flow field around clustered particles in the step-channel. To estimate the change of drag force acting on clustered particles in the sharply expanded microfluidic step-channel, numerical simulation was carried out using a commercially available code (Comsol Multiphysics, COMSOL Group, USA). Inset shows model of the clustered particles. The simulation results show that the clustered particles A located at the upstream of microfluidic channel are exposed to high flow velocities while the clustered particles B is exposed to significantly decreased flow velocities. The magnitude of drag force acting on the clustered particles A is 5 times bigger than that acting on the clustered particles B. This indicates that the drag force significantly decreases after the step, and the clustered particles can be efficiently trapped by the DEP force.

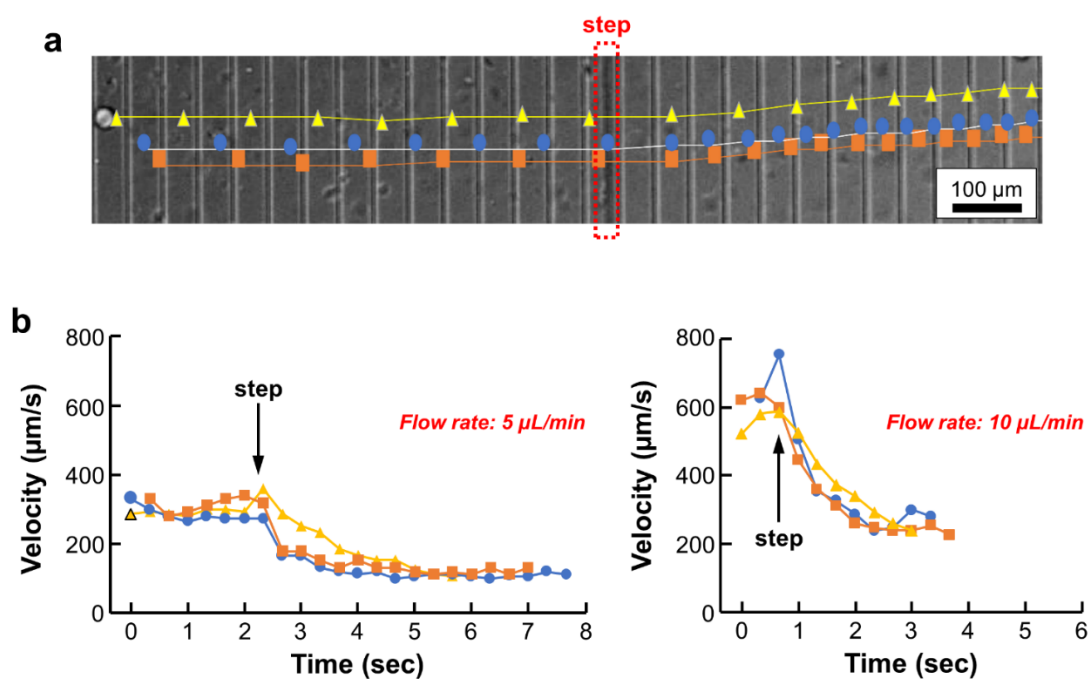


Fig. S2 Changes of velocities before and after the step inside the microfluidic channel. (a) The trace of microbeads with a diameter of 30  $\mu\text{m}$  at a flow rate of 5  $\mu\text{L}/\text{min}$ . Each shape as well as line represents the trace for different microbeads. The images for each point were taken at a same interval, which means that the velocity decreases as the distance between two neighbouring points decreases. (b) The velocity of microbeads at two different flow rates, 5  $\mu\text{L}/\text{min}$  and 10  $\mu\text{L}/\text{min}$ , respectively. It was confirmed that the velocity dropped after the step.

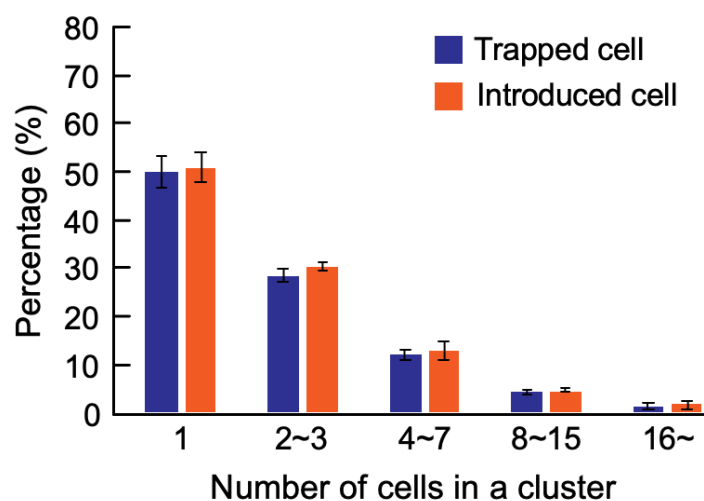


Fig. S3 Comparison of the distribution of cells constituting the clusters between the introduced sample and the trapped cells.

## Supplementary Movie Legends

### **Supplementary Movie 1. Representative single cell trapping using MOE.**

The suspension of DU-145 cells was introduced into the device and delivered to the microfluidic device at a flow rate of 5  $\mu\text{L}/\text{min}$ . Single cells were trapped in MOE with positive DEP by applying 1.7 V at 5 MHz to the electrodes.

### **Supplementary Movie 2. Representative cluster trapping using MOE.**

The suspension of clusters was introduced into the device and delivered to the microfluidic device at a flow rate of 5  $\mu\text{L}/\text{min}$ . One of the cells that constitutes a cell cluster was trapped in MOE with positive DEP by applying 2.1 V<sub>pp</sub> at 5 MHz to the electrodes.