### Supplementary Information

# A high-throughput standing surface acoustic wave (SSAW)-based cell sorter

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## S1. The width of SSAW area generated by FIDTs with different geometric focal length *R*

In order to investigate the effects of different focal length *R* on the actual beam width, we fabricated four pairs of FIDTs with a focal length *R* of 500  $\mu$ m, 1000  $\mu$ m, 1500  $\mu$ m, and 2000  $\mu$ m, respectively. These FIDTs have the same degree of arcs (10°). 10  $\mu$ m polystyrene particles were used to visualize the acoustic field around the focal point of each pair of FIDTs. As shown in Fig. S1, the particles were patterned at their input power thresholds respectively. The widths of SSAW area were measured and plotted versus the geometric focal length *R*. Although the actual beam width increases as *R* increases (Fig. S1(b)), the difference is not significant (less than 25  $\mu$ m from *R*= 500  $\mu$ m to *R*= 2000  $\mu$ m).



Fig. S1. (a) Optical images on SSAW-based particle patterning. These particles were patterned by FIDTs with different geometric focal length *R* at their input power threshold, respectively. The *R* are 500  $\mu$ m, 1000  $\mu$ m, 1500  $\mu$ m, and 2000  $\mu$ m. The degree of arcs is 10°. (b) The width of SSAW area are plotted versus the geometric focal length *R* of FIDTs.

#### S2. The numerical simulation model of the substrate surface displacement

The substrate surface displacement under the SSAW were numerically simulated by a piezoelectric device module in COMSOL 4.3a (COMSOL Inc.). The geometries of FIDTs and SIDTs in the simulation are shown in Fig. S2(a) and Fig. S2(b) respectively. The geometries of IDTs in the simulation are the same size as the experimental device, except that only 8 pairs of IDT fingers are included. The power intensity of RF signals applied to the IDTs is set as 1 W and the frequency is 38.8 MHz. After the module is solved at frequency domain, the substrate surface displacement are compared between SIDTs and FIDTs. The black line in Fig. S2 indicated the position where



Fig. S2 Numerical simulation of the substrate surface displacement excited by (a) FIDTs and (b) SIDTs. The distance between two pairs of IDTs is set as  $1000 \ \mu m$ .

we extracted the substrate surface displacement in Fig. 3(b).

#### **Video Legends:**

#### Supplementary Video 1: High-throughput sorting of polystyrene particles

This video corresponds to the data presented in Figure 6. 10  $\mu$ m polystyrene particles flowed through the channel at a throughput around 3300 events/s. Periodic pulse signals with a repeatability of 200 Hz were applied to the SSAW sorter and the actuation time of each pulse was set as 72  $\mu$ s. One and only one particle was sorted into the collection outlet by each pulse signal every 5 ms. The video was captured at 4500 frames per second and played at 4 frames per second.