

Electronic Supplementary Information (ESI) for Lab on a Chip

Optoacoustic tweezers: a programmable, localized cell concentrator based on opto-thermally generated, acoustically activated, surface bubbles

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1. Concentrating effect on cells with different sizes

HeLa cells (diameter about 20 μm) and *Yeast* cells (diameter about 5 μm) were used to demonstrate that the acoustically acticated, bubble-based cell concentrating mechanism is dependant on the size of the cells. The results are shown in Fig. S1. Before the acoustic treatment, all cells are distrubuted randomly (Fig. S1a). After acoustic treatment for about 10 s (Fig. S1b), *HeLa* cells move to the bubble surface because of the acoustic radiation force; on the other hand, *Yeast* cells flow with the streaming, because the ratio between the drag force and the radiation force is larger when the cell radius is small (as discussed in Fig. 3d in the manuscript). In addition, the cell trajectories were recorded by the camera; the resulting video was stacked into Fig. S1c. It is observed that *HeLa* cells resolve near the bubble surface, while the *Yeast* cells are repelled from the bubble due to acoustic streaming. The cell

concentrating effect was further characterized statistically. The distance between each *HeLa* cell and the distance from each *HeLa* cell to the bubble surface decreased much more significantly than those for *Yeast* cells, which confirmed the mechanism of acoustic cell trapping.

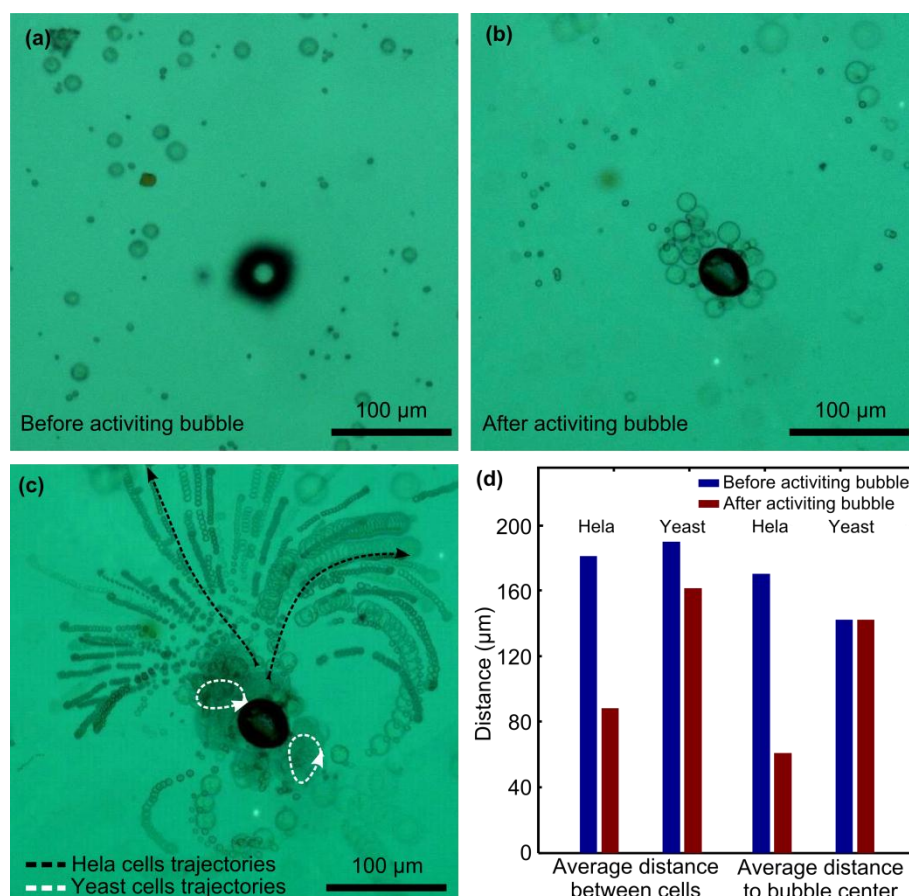


Figure S1 Concentrating effect on cells of different sizes: *HeLa* cells (diameter about 20 μm) and *Yeast* cells (diameter about 5 μm). (a) Before acoustic treatments, two kinds of cells distributed randomly in the medium. (b) After acoustic treatments, *HeLa* cells aggregate toward the bubble surface, while *Yeast* cells remain randomly distributed. (c) Cell trajectories during acoustic treatments; *HeLa* cells move towards the bubble surface and revolve near the bubble, while *Yeast* cells move with streaming effect. (d) Statistics of distances between cells and distances to the bubble center for both cells; results indicate that *HeLa* cells aggregated much more significantly than the *Yeast* cells.

2. Control group for cell adhesion experiments in the absence of a bubble

A cell adhesion test was also conducted in the control group, in which no bubble was generated but all other experimental parameters are kept unchanged. The cell attaching result is shown in Figure S2. In the control group, cells were attached to the cell culture slides, the same as experimental group (Figure 4d in the manuscript). The morphology was the same as the experimental group. This data indicates that bubble will not affect the cell attach performance.

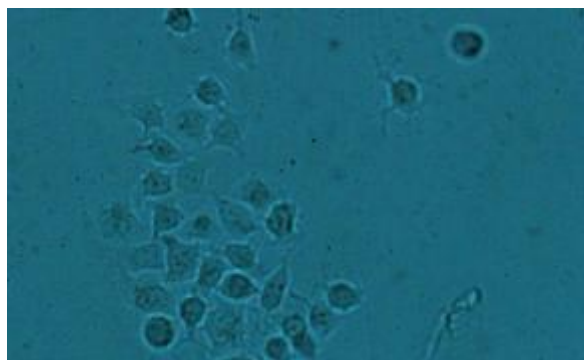


Figure S2 Cells attached to the cell culture slides in the absence of a bubble.