Supporting Information

Selecting active matter according to motility in an acoustofluidic setup: Self-propelled particles and sperm cells

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Discussion of results presented in Figure SI1.

Initially, the applied voltage is set to a high value, U = 40 mV. All the particles, active and passive, are inside the focused flow thus showing no separation (Fig. SI2(a) and Movie-SI05). When gradually decreasing the voltage, the following behavior is observed. At U = 30 mV, some of the active Janus particles escape the focusing potential and are collected outside the central gate while all other particles (all the passive and some of active) go through the central gate. Thus, a partial separation is observed at U = 30 mV (Fig. SI2(b) and Movie-SI06). Further weakening of the focusing potential, U = 20 mV, results in the picture shown in Fig. SI2(c) and Movie-SI07, when most of the Janus particles are detected outside the central gate while all the passive particles and fewer active particles go through the central gate. Applying an even weaker focusing potential, U = 10 mV, results in a visible broadening of the central focused flow which still remains inside the central gate. At the same time, most of the Janus particles are outside the gate which implies efficient separation (Fig. SI2(d) and Movie-SI08). Finally, the focusing potential is off. The flow becomes dispersed, and both the species, active and passive, arrive randomly to the detector: no separation (Fig. SI2(e) and Movie-SI09).

The main difference as compared to the case of a stronger trapping potential is that now motile sperm are not trapped by the potential (but tend to be focused), and they can be collected separately already at the position where they leave the potential region (or even inside the region of the action of the potential). Again, as in the case of a stronger potential, the most active sperm can be collected further away from the central line of the channel.

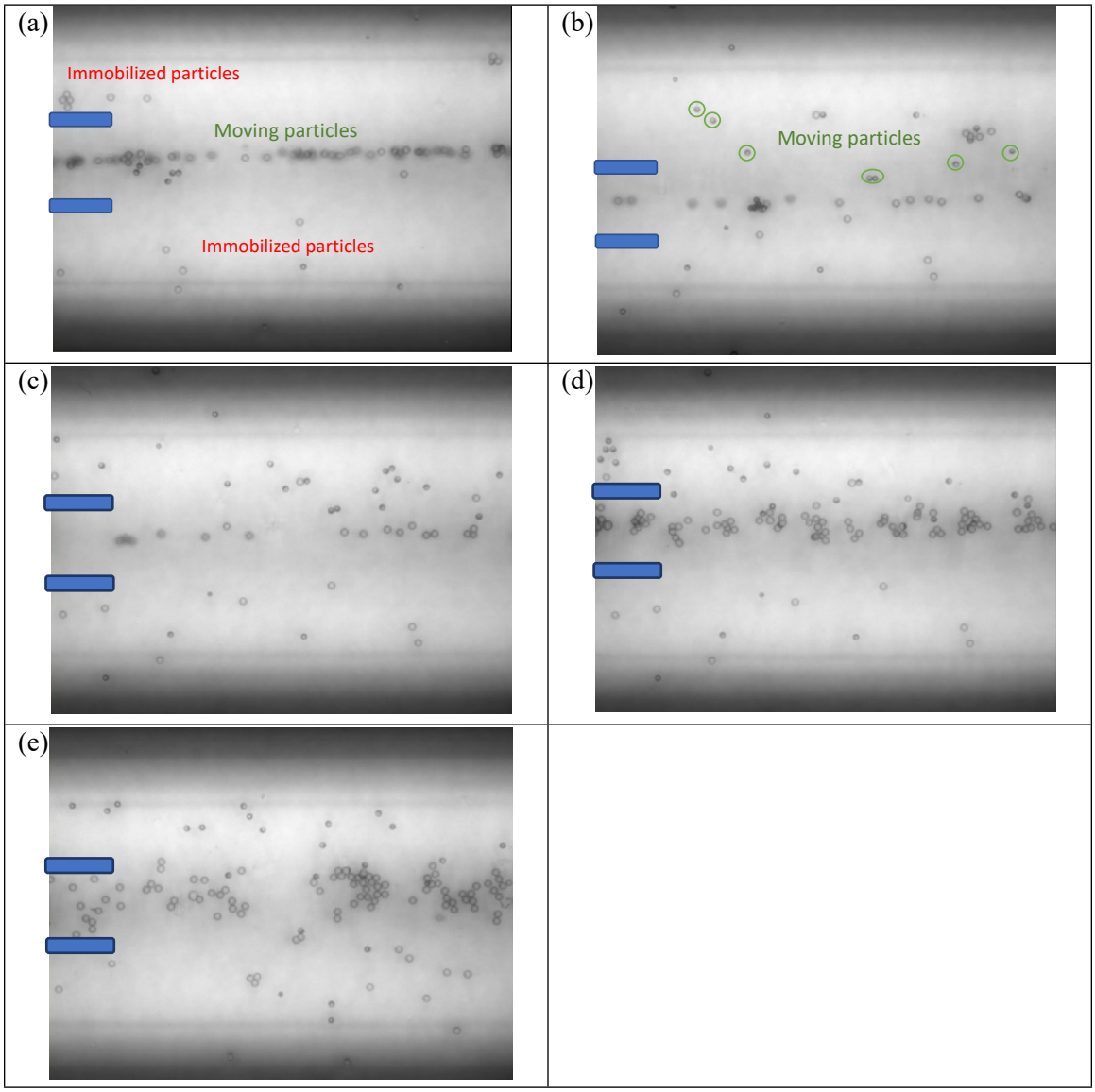

Figure SI1. (Experiment) Escape of motile Janus particles (double-sided particles: the Pt-covered part is dark, and the PS open part is bright) from the acoustic focusing potential and their separation from non-motile species (passive beads, bright particles). The flow is from the right to the left. The blue rectangles on the left show the gate separating the central flow from the side flows. (a) The focusing potential is strong (the applied voltage U = 40 mV): all the particles, active and passive, are focused and collected inside the gate; no separation. (Few particles seen outside the gate are immobilized.) (b) The focusing potential is weaker: U = 30 mV. Some of the active Janus particles (indicated by green circles) escape the focusing potential and can be collected outside the central gate while all other particles go through the gate: partial separation of motile particles. (c) U = 20 mV: most of the Janus particles are detected outside the gate, i.e., separated from the rest of the particles. (d) A weak focusing potential, U = 10 mV. The central flow of passive particles is dispersed but still is kept inside the gate, while most of the Janus particles are outside the gate: efficient separation. (e) The focusing potential is off. The flow is dispersed, and both the species, active and passive, arrive randomly to the detector: no separation.