Bio-convective transport for selective particle sorting

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Biological microswimmers are able to convert energy into motion and employ diverse strategies to efficiently navigate complex fluid environments at microscopic scales. Microswimmers have drawn significant attention for their potential applications in biomedicine, in particular for cargo transport and drug delivery tasks[1]. The microswimmer *Chlamydomonas reinhardtii*, a quasi-spheric 10 µm long microalga, is of particular interest for its ability to swim towards or away from light sources, known as phototaxis. When the *C. reinhardtii* concentration becomes high enough, bio-convective structures can appear and affect the surrounding fluid[2,3].

This study shows how the phototactic behavior of microalgae can be harnessed to control the transport of passive particles, converting their random motion into directed transport. We enclose micron-sized particles (from 30 µm to 200 µm in diameter) in microalgae suspensions within a squared centimetric chamber and use LEDs to drive algae accumulation. This accumulation generates bioconvective flows, which push denser beads away from algae-dense regions while pulling lighter beads toward them. We can effectively direct the transport of these microparticles and sort them according to both their densities (Figure 1, left) and their friction properties against the wall (Figure 1, right).

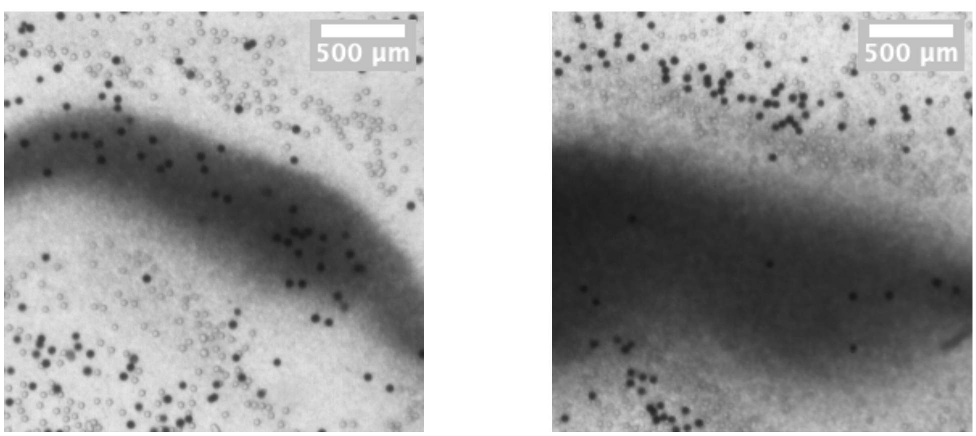

Figure 1. Snapshots of *C. reinhardtii* baths containing beads of various densities, with diameters ranging from 40 µm to 50 µm. The dark regions in both snapshots are regions of high algae concentration. (Left) Black floating beads of density 0.99 g/mL are gathered at the center of the CR swarm while the sedimented white beads of density 1.05 g/mL are repelled by it. (Right) Black sedimented beads of density 1.01 g/mL are repelled further than the white beads of density 1.05 g/mL.

Références

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