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Magnetic Tethering of Microswimmers in Microfluidic Devices
ASCHVIN CHAWAN, SAIKAT JANA, SUVOJIT GHOSH, SUNGHWAN JUNG, ISHWAR K. PURI, Engineering Science and Mechanics, Virginia Tech — Exercising control over animal locomotion is well known in the macro world. In the micro-scale world, such methods require more sophistication. We magnetize Paramecium multimicronucleatum by internalization of magnetite nanoparticles coated with bovine serum albumin (BSA). This enables control of their motion in a microfluidic device using a magnetic field. Miniature permanent magnets embedded within the device are used to tether the magnetized organisms to specific locations along a microchannel. Ciliary beatings of the microswimmer generate shear flows nearby. We apply this setup to enhance cross-stream mixing in a microfluidic device by supplementing molecular diffusion. The device is similar to an active micromixer but requires no external power sources or artificial actuators. We optically characterize the effectiveness of the mechanism in a variety of flow situations.

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