Nanorobotic swimmers: fabrication, control and applications

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Micro/nanoscale robotic swimmers have a great potential to biologic or biomedical applications where conventional tools cannot be applied. Although their swimming capability inside microfluidic channels is essential to various in vivo and in vitro applications, efficient and robust propulsion is still challenging due to low Reynolds physics and dominant surface effects [1]. Various helical nanoswimmers mimicking nature's flagella have recently been demonstrated but none of them demonstrated closed microfluidic channel navigations [2-4]. In this abstract, we show that our recently developed multiflagella artificial bacteria (MAB) are able to swim inside microfluidic channels. The MABs are fabricated by 3-D lithography based on two-photon laser absorption (Fig. 1). The lithographically patterned MABs are metalized with ferromagnetic layer. The tumbling and rolling motions of MABs are controlled by electromagnetic coil setup under optical microscope (Fig. 2). The magnetically controlled MABs can trap particle by creating local vortex and also travel through the microfluidic channel under dynamic pressure (Fig. 3).

References

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[2] L. Zhang et al., Appl. Phys. Lett., 12 (2012) 064107.
[3] G. Hwang et al., Intl. J. Rob. Res., 30 (2011) 806-819.
[4] S. Tottori et al., Adv. Mats., 24 (2012) 811-816.

Figures

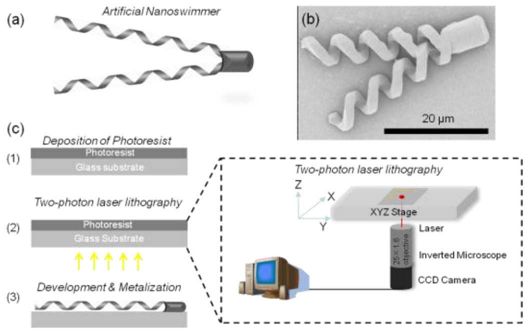

Fig. 1 Design and fabrication of MAB

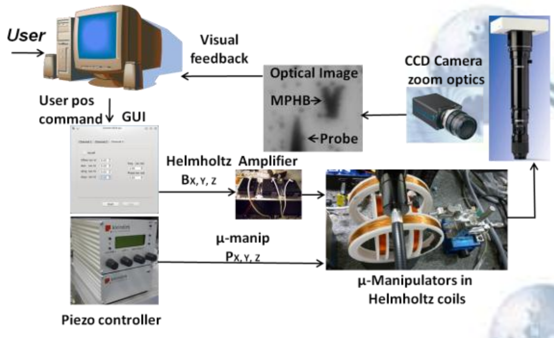

Fig. 2 Magnetic control system overview

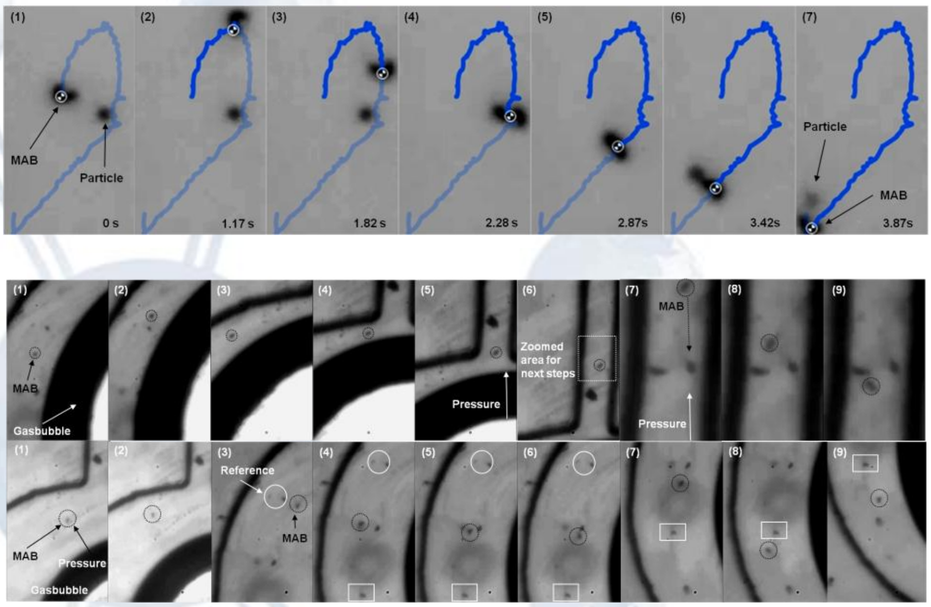

Fig. 3 Controlled particle trapping and transport by vortex (top) and propulsion inside microfluidic channels under dynamic pressure (middle and bottom)