MEXT Grant-in-Aid for Scientific Research on Priority Areas, No. 438「Next Generation Actuators Leading Breakthroughs」

Non-Contact On-chip Manipulation of 3-D Microtools and its Applications

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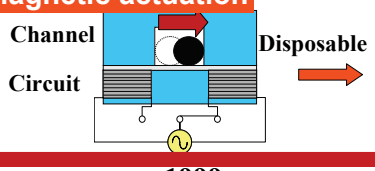
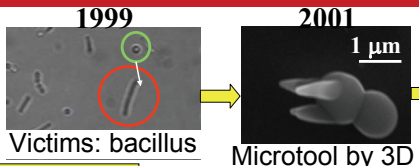
I. Abstract

We have developed novel magnetically driven **polymeric microtools** which have features of 1. **Fabrication of any 2D shape**, 2. **Soft and biocompatible**, 3. **No stiction**, 4. **Mass production** with **low cost**. The tools have been operated as **rotor, mixer, loader, valve** and **sorter** on a chip which contribute to the **on-chip cell manipulations.** Also, we have developed many kinds of photo-fabricated microtools for optical tweezers manipulations. These technologies provide non-contact and high-accurate manipulations in the field of bio-industries.

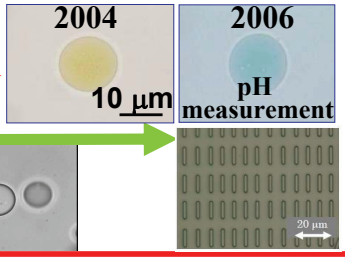
Magnetic actuation



1. Multi-function
2. Arbitrarily-shaped
3. Multiple DOF

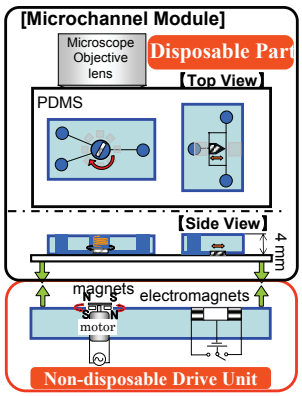


Functionalization
Photolithography
3D-6DOF



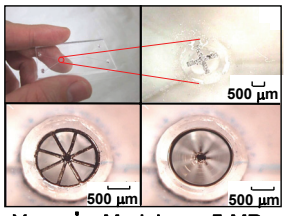
Optical actuation

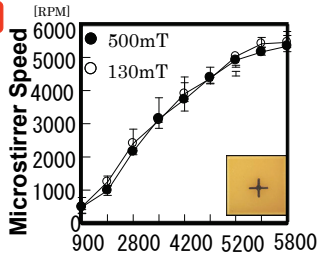
Ⅱ. Magnetic Actuation



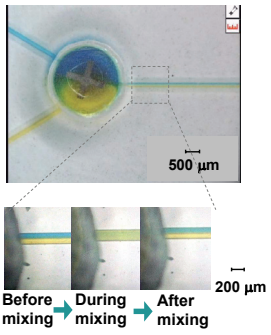
(a) Continuous Rotation

[ex.] Microstirrer





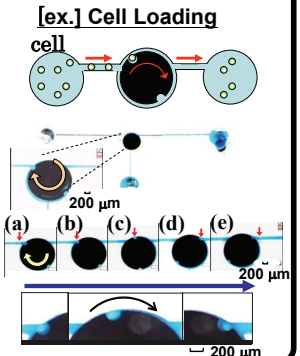
Max RPM ≈ 5000 rpm



Young's Modulus ≈ 5 MPa, Magnetite (Fe_3O_4) : 50%

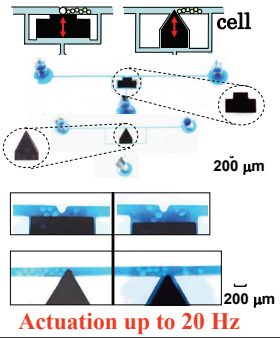
(b) Step Rotation

[ex.] Cell Loading



(c) Vertical Actuation

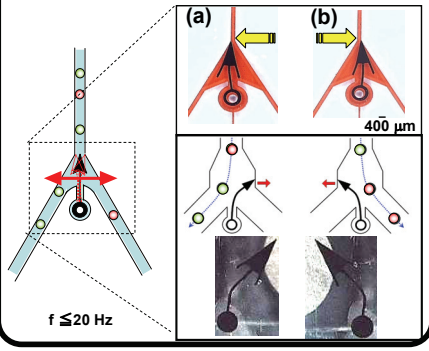
[ex.] Microvalve



Actuation up to 20 Hz

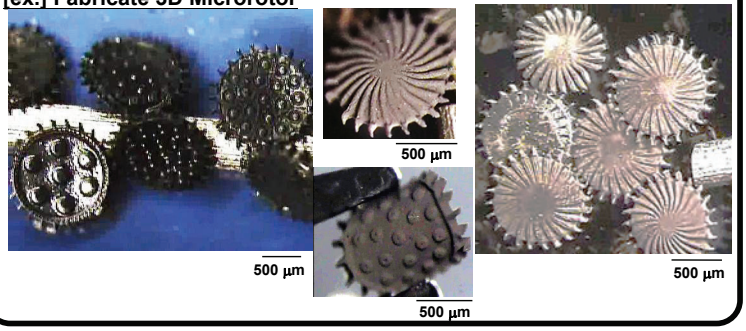
(d) Deformed Actuation

[ex.] Microsorter



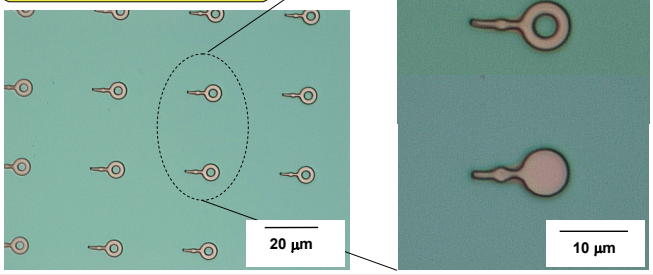
(e) 3D Magnetically Driven Microtools by Grey-scale by lithography techniques

[ex.] Fabricate 3D Microrotor

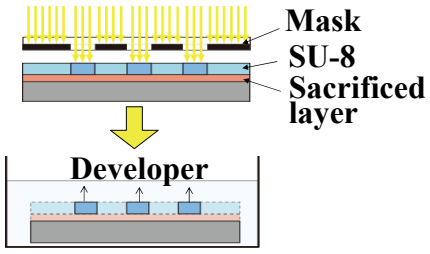


Ⅲ. Optical Actuation

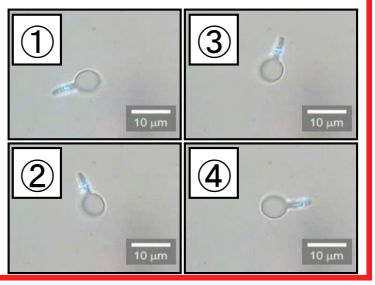
SU-8 microtools



Fabrication of Microtools for Optical Tweezers



Operation of Microtools by Optical Tweezers



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TECHNO-FRONTIER 2008 (16th – 18th of April) Makuhari, Tokyo