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

Fumihito Arai and Yoko Yamanishi
Department of Bioengineering and Robotics, Tohoku University

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
- Channel
- Circuit
- Disposable
- Wire
- Molding, photolitho.
- Low friction, flexibility

Optical actuation
- Photolithography
- 3D-6DOF

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

II. Magnetic Actuation

(a) Continuous Rotation
- Microirrer
- Motor Speed Index
- Young's Modulus = 5 MPa, Magnetite (Fe3O4) : 50%
- Max RPM = 5000 rpm

(b) Step Rotation
- Cell Loading

(c) Vertical Actuation
- Microvalve
- Actuation up to 20 Hz

(d) Deformed Actuation
- Microsorter

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

SU-8 microtools

Fabrication of Microtools for Optical Tweezers
- Mask
- SU-8
- Sacrificed layer
- Developer

Operation of Microtools by Optical Tweezers
- 1
- 2
- 3
- 4

Contact Address: Fumihito Arai arai@imech.mech.tohoku.ac.jp, yoko@imech.mech.tohoku.ac.jp

Actuator Laboratory, Department of Bioengineering and Robotics, Tohoku University, http://www.imech.mech.tohoku.ac.jp/

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