We present a novel fabrication method of three dimensional polymeric magnetically driven microtools (3D-MMT) for non-intrusive and no contamination experiments on a chip. A grayscale photolithography technique has been applied and produced smoothly curved (100 μm gap) object without steps. A wide range of on-chip application of microactuators by 3D-MMT have been proposed to complicated and sensitive motion such as microloader, uniquely actuated by a combination of magnetic and fluidic force.

**Background:**

**New Protocol of Cloning Technique**

- Removing zona pellucida
- Oocyte bisection
- Separation of enucleated demi-oocyte
- No use
- Coupling with donor cell
- Embryonic cell with genetically identical offspring

**Fabrication:**

**Gray-scale Lithography Technique**

- Parallel UV Ray
- Grayscale Mask
- Thick nega-photoresist
- Back side of Glass Substrate
- Light Proof Box
- Image Setter Film
- 1/20Reduction
- Reduction Lens
- Parallel UV Ray
- Gray Emulsion Glass Mask
- KMPR Photoresist
- UV Glass Substrate
- ① Photolithography
- ② Backside Exposure
- ③ PDMS-magnetite composite
- ④ Completed 3D MMT
- ⑤ Glass Substrate Stripper Liquid

**Produced 3D MMT**

**Operation of Loading**

- Fluidic force
- Magnetic force
- (a) t = 0 [sec]
- (b) t = 2.5 [sec]
- (c) t = 4.5 [sec]

**Experiments:**

**3D MMT Valve**

- MMT Valve
- Blocking of Multi-particles
- Transportation of Agglomerated Particles
- Requirement of Loading of Agglomerated Particles

**Conclusions:**

- We have developed 3D-MMT for cell-laden on-chip experiment.
- The 3D-MMT has a smooth curvature with 100 μm gap fabricated by gray-scale lithography techniques.
- The loading function was obtained by rotation of 3D-MMT.
- Gear-shaped MMT improved the efficiency of loading of particles with a combination of magnetic and fluidic forces.

**References:**