Robust, Ultra-Flexible, Micro-Encoded Ferromagnetic Tape for Bioseparation and Assembly

Tech ID: 29770 / UC Case 2015-154-0

SUMMARY

Researchers at the UCLA Department of Bioengineering have developed methods to embed electroplated magnetic materials within elastomeric materials and use these flexible magnetic hybrid materials for biological applications.

BACKGROUND

Flexible magnetic devices provide unique opportunities to dynamically and remotely interface with biological systems. Currently, flexible magnetic devices are primarily made of micron-scale, physically-addressable magneto-structures (magnetic cilia), which consist of composite structures of PDMS-magnetic particles or nickel itself. These flexible magnetic devices are often used to apply forces to cells, manipulate droplets, generate fluidic motion, and lend sensing capabilities to more diverse environments. However, existing fabrication methods is limited for making flexible magnetic devices with sufficient strength and microstructure precision.

INNOVATION

Researchers at UCLA have developed methods to covalently link and embed user-defined (in microscale thickness, size, and structure) ferromagnetic elements within highly flexible, silicone and other elastomeric materials of varying elastic modulus (10 kPa to 1MPa). Magnetic structures are fabricated directly above saline-solution soluble thin films, which can be released into an embedded material by the end user for dynamic routing and manipulation of a magnetic field and creation of high magnetic field gradients. The flexible structures may be integrated with microfluidic devices, eppendorf tubes, and catheters to enable patternable and tunable separation of magnetic particles (including magnetic nanoparticle-dosed cells), which would significantly increase the speed, and dynamic spatial and temporal control over particle positioning. The flexible structures would also have applications for concentrating particles that are to be injected as a therapeutic, or those that are designed to interact with biological matter, such as bacteria in a sepsis patient. The tunable control over particles can be further extended into dynamic manipulation of magnetic droplets or control of particles in ferrofluids.

APPLICATIONS

- Tunable separation of magnetic particles with enhanced speed, and dynamic spatial and temporal control
- Biomatter concentration and separation
- Dynamic assembly of macrostructures embedded with magnetic microstructures
- Manipulate magnetic droplets across three-dimensional surfaces

ADVANTAGES

- User-definable magnetic element size, structure and pattern
- Tunable separation and assembly of particles with better spatial and temporal control
- Dynamic control of particle mobility on three-dimensional surfaces

STATE OF DEVELOPMENT

Device prototype is available.

RELATED MATERIALS

- Tseng, P., Lin, J., Owsley, K., Kong, J., Kunze, A., Murray, C. and Di Carlo, D., 2015. Flexible and stretchable micromagnet arrays for tunable biointerfacing. Advanced Materials, 27(6), pp.1083-1089.

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INVENTORS

- Di Carlo, Dino

OTHER INFORMATION

KEYWORDS

Flexible electromagnetics, magnetic separation, magnetic droplet, biomagnetism, bioseparation

CATEGORIZED AS

- **Materials & Chemicals**
  - Composites
  - Polymers
  - Thin Films
- **Medical**
  - Delivery Systems
  - Devices
  - Other
  - Research Tools
- **Research Tools**
  - Other
- **Sensors & Instrumentation**
  - Other

RELATED CASES

2015-154-0

▶ Tseng, P., Judy, J.W. and Di Carlo, D., 2012. Magnetic nanoparticle–mediated massively parallel mechanical modulation of single-cell behavior. Nature methods, 9(11), p.1113.

▶ Tseng, P., Di Carlo, D. and Judy, J.W., 2009. Rapid and dynamic intracellular patterning of cell-internalized magnetic fluorescent nanoparticles. Nano letters, 9(8), pp.3053-3059.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,144,911	12/04/2018	2015-154

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Integrated Isolation, Emulsification, And Single-Cell Assay
- Monodisperse Emulsions Templated By 3D-Structured Microparticles
- Enhanced Fluorescence Readout And Reduced Inhibition For Nucleic Acid Amplification Tests
- Label-Free Digital Bright Field Analysis of DNA Amplification
- Microfluidic Platform to Control Particle Placement and Spacing in Channel Flow
- Controllable Emulsification and Point-Of-Care Assays Driven by Magnetic Induced Movement of the Fluid

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