Plasmonic Nanoparticle Embedded PDMS Micropillar Array and Fabrication Approaches for Large Area Cell Force Sensing

Tech ID: 29040 / UC Case 2016-044-0

SUMMARY

UCLA researchers in the Department of Mechanical and Aerospace Engineering have developed a novel cell force sensor platform with high accuracy over large areas.

BACKGROUND

Microfabricated elastic pillar substrates with various geometries have been widely used for drug development, cell stiffness studies to probe for cancer, and to understand mechanotransduction of cell functions. To obtain high contrast, fluorescent labels typically are used at the tips of the pillars, which either degrade, are digested by the cells, or dissolve in media over time. Likewise, they are not uniformly coated on the pillars and require high magnification (> 60x) to obtain 30 nm to 50 nm position resolution of the pillar. This results in a limited field of view (FOV), less than 100 µm x 100 µm, and makes it difficult to monitor large scale cell behavior and to provide high throughput and large area measurements.

INNOVATION

Researchers led by Professor Chiou have invented a novel plasmonic cell force sensor platform with superior force sensing across large areas. This system can be fabricated on silicon substrates using standard microfabrication techniques with a spatial resolution of ~30 nm under a 20x objective lens and a 450 µm x 340 µm FOV. This plasmonic nanoparticle (NP) embedded micropillar material provides a strong signal-to-noise ratio for high precision position tracing and a point-source-like image pattern for sub-pixel resolution tracing, even under low magnification. The plasmonic NPs in this system can be used as a heating source for single cell ablation applications or used to porate cells for large area drug delivery.

APPLICATIONS

- Cell stiffness measurements for cancer detection
- Single cell ablation
- Drug delivery via poration
- Drug development

ADVANTAGES

- 30 nm spatial resolution using 10x magnification
- 450 µm x 340 µm FOV
- Excellent signal-to-noise ratio and high precision position tracing
- Sub-pixel resolution at low magnification
- Single cell heating for inducing cell death or poration for drug delivery
- Uses standard microfabrication techniques

STATE OF DEVELOPMENT

Prototype plasmonic NP-embedded micropillar array devices have been fabricated and cell forces were successfully mapped over the pillar array with a 20x objective lens using Madin-Darby canine kidney epithelial cells.

PATENT STATUS

Country	Type	Number	Dated	Case

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Plasmonic nanoparticles, micropillar, PDMS, microfabrication, cell force sensing, cell stiffness, single cell ablation, cell heating, plasmonic heating, cell poration, drug delivery, mechanotransduction

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Biotechnology**
  - Health
- **Engineering**
  - Engineering
  - Other
- **Materials & Chemicals**
  - Nanomaterials
  - Other
- **Medical**
  - Devices
- **Nanotechnology**
  - Materials
  - NanoBio
  - Tools and Devices
- **Sensors & Instrumentation**
  - Biosensors
  - Medical

United States Of America	Issued Patent	10,712,271	07/14/2020	2016-044	▶ Physical Measurement

RELATED CASES

2016-044-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Mechanisms and Devices Enabling Arbitrarily Shaped, Deep-Subwavelength, Acoustic Patterning
- ▶ Single-Pixel Optical Technologies For Instantly Quantifying Multicellular Response Profiles
- ▶ Self-Locking Optoelectronic Tweezer And Its Fabrication
- ▶ A Device For Continuous Focusing And Rotation Of Biological Cells And Its Application For High Throughput Electrorotation Flow Cytometer

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