Magnetic Nanodiscs Mediate Remote Magnetomechanical Control of Neural Calcium

Technology #20085

Applications

This technology enables the transgene-free control of cellular calcium flux for applications in neurobiology research.

Problem Addressed

The use of magnetic fields for the minimally invasive control of cell signaling molecules, such as calcium, is gaining recognition as an approach to studying the nervous system and mechanosensitive cell biology. In fact, wireless strategies using high-frequency alternating magnetic fields to heat magnetic nanoparticles have already been demonstrated to permit the regulation of neural activity in vivo. However, the off-target effects of magnetothermal approaches, including cellular damage, and the challenges in scaling high-frequency alternating magnetic field apparatuses are obstacles to the widespread adoption of these strategies in biomedical applications. Therefore, there is a need for scalable magnetic devices that can be used in conjunction with lower-frequency magnetic fields to control and study cellular activity and signaling without compromising cellular viability. The present invention is a novel method and device that provides remote magnetomechanical control of mechanosensitive cells to regulate calcium flux utilizing low-frequency magnetic fields and magnetic nanodiscs.

Technology

This technology employs biocompatible anisotropic magnetite magnetic nanodiscs (MNDs) that, when exposed to low-magnitude magnetic fields, induce changes in cellular membrane tension to activate ion channels. When the MNDs are incubated with cells such as dorsal root ganglia explants, they form an interface with the surface of cell membranes. When a low-frequency, low-amplitude magnetic field is then applied to the cell culture, the MNDs transduce the magnetic field into magnetic force. The magnetic force exerted from the MNDs creates membrane tension via torque and is sufficient to activate mechanosensitive channels such as calcium channels. Thus, this technology achieves the precise modulation of calcium flux in neurons and other mechanosensory cells in a minimally invasive manner without the use of transgenes.

Advantages

- Capable large-volume cellular calcium modulation without the use of transgenes
- Inexpensive to implement - uses off-the-shelf materials
- No need for heating magnetic particles, which can reduce cellular viability

Intellectual Property

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Categories For This Invention:

Life Sciences
Biomaterials
Micro/nanoparticles (Biomaterials)
Research Tools
Micro/nanoparticles (Research Tools)

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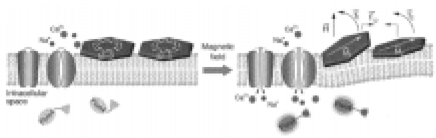
External Links:

Bioelectronics Group Website
https://www.rle.mit.edu/bioelectron/

Image Gallery:



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