Deep Brain Stimulation Using Magnetic Brain Array (20150177, Dr. Jian-Ping Wang)

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Magnetic Modulation of Neuron Cells

A first-ever magnetic brain array can modulate (stimulate) neuron cells and other biological components sensitive to magnetic fields. The array offers low energy consumption and high density, and consists of magnetic tunneling junction (MTJ) sensors for 3D mapping with potential for closed-loop operation. The technique generates magnetic fields for biomedical applications by rotating a magnetic layer in an MTJ and using electrical current and/or light to modulate the magnetic status of the magnetic nanostructures. The magnetic nanostructure stimulation array is integrated with a magnetic sensor mapping array into one chip for simultaneous mapping.

Electrode Based Neuron Modulation Array Alternative

Current electrical-based stimulation devices have limited ability to "steer" stimulation to highly targeted locations. Moreover, the simulation points must be in direct contact with the targeted tissue. This new magnetic array offers more precise stimulations of the intended target, thereby reducing stimulation-induced side effects. It features an array of magnetic (not electrical) nanowires in which localized magnetic stimulation is generated to provide non-contact stimulation. Compared to state-of-art electrode based neuron modulation array, this new array reduces power requirements, offers higher density arrays than standard electrical-based DBS, and delivers more precise stimulation.

BENEFITS AND FEATURES:

- Significantly reduced power requirement (longer battery life) expected
- Higher density arrays than standard electrical-based DBS (could be 100 times more packed)
- High resolution (could be down to 0.1 micron meter or lower)
- May offer more precise stimulation delivery than current electrical stimulation techniques

- Array consists of magnetic tunneling junction (MTJ) sensors for 3D mapping (potential for closed-loop operation)
- Low power consumption; magnetic domains movement and/or MTJ switching demand much less power
- Magnetic sensor array integrated for mapping simultaneously
- Compatible to optical fiber

APPLICATIONS:

- Electrical-based DBS devices
- Brain stimulation
- Modulating neurons
- Stimulating other biological components sensitive to magnetic fields

Phase of Development - Prototype development

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