Researchers use upconversion nanoparticles to understand brain functions

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Scientists from the National University of Singapore (NUS) have worked with an international research team to jointly develop a novel approach for deep brain stimulation. The new method utilizes upconversion nanoparticles developed by Professor Liu Xiaogang from the Department of Chemistry at NUS Faculty of Science to allow delivery of visible light deep into the brain to stimulate neural activities in a less-invasive manner. This innovation marks a significant breakthrough in optogenetics, empowering researchers to uncover valuable insights about the brain.

Optogenetics is a widely adopted research technique in the field of neuroscience that makes use of visible light to activate or inhibit neurons in the brain, enabling researchers to examine the brain's functions in a minimally invasive manner. The inability of visible light to penetrate into deep brain structures, however, remains a major experimental challenge for this technique, and current deep brain stimulation still requires the insertion of an optical fiber directly into the brain.

To make deep brain stimulation less invasive, Prof Liu and his colleagues began exploring with near-infrared light, known to possess significantly higher tissue penetration capability and also relatively safe for biological samples. Using a two-step process, upconversion nanoparticles are first introduced into the brain by transcranial injection. Upon reaching deep brain, the implanted upconversion nanoparticles, a unique group of luminescent nanomaterials capable of converting near-infrared

light into visible light then generates visible light which acts to stimulate the neurons. The strategy has shown to be effective in triggering memory recall and dopamine release in the team’s experiments.

This novel approach offers a simpler, less-invasive alternative to fiber-optic implantation for deep brain stimulation, and holds immense potential in facilitating advancement in neuroscience.

Prof Liu, who is the co-author of the study, said, “We have addressed a long-standing experimental challenge faced by neuroscientists with the latest nanotechnology, and it has proven to be an effective strategy for delivering excellent deep brain stimulation with once unimaginable precision. Neuroscientists can therefore leverage this method to visualize the brain state and uncover new clues that will pave the way for novel therapeutic strategies against neurological disorders such as Parkinson’s disease.”

Source:

http://news.nus.edu.sg/press-releases/deep-brain-stimulation

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