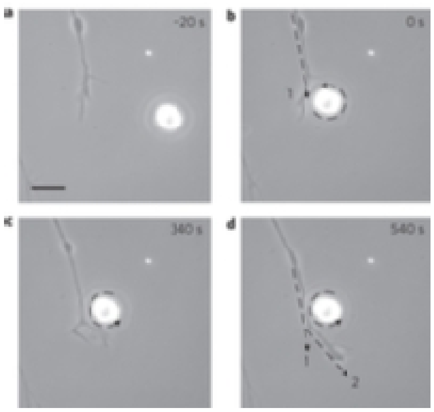
Physicists 'turn signals' for neuron growth

December 15 2011



Time-lapse images when a Vaterite particle is rotated anticlockwise and positioned to the left of the axon defined by the growth direction of the axon (dashed arrow 1). (From Nature Photonics)

(PhysOrg.com) -- A new paper scheduled for publication in the January issue of *Nature Photonics* describes the use of spinning microparticles to direct the growth of nerve fiber, a discovery that could allow for directed growth of neuronal networks on a chip and improve methods for treating spinal or brain injuries.

Samarendra Mohanty, an assistant professor of physics at The University of Texas at Arlington, is a coauthor of the paper, which is now available online.

The study is based on Mohanty's hypothesis that neurons can respond to physical (e.g. fluid flow) cues in addition to chemical cues. He conducted the seminal work and observed that a laser-driven spinning Calcite microparticle could guide the direction of neuron growth. Its rotation caused a shearing effect by creating a microfluidic flow.

Mohanty's work led the University of California, Irvine team led by Professor Michael Berns to test the Vaterite "micro-motors" in guiding neurons.

Mohanty said: "This is the first report to demonstrate that neurons can be turned in a controlled manner by microfluidic flow. With this method, we can direct them to turn right or turn left and we can quickly insert or remove the rotating beads as needed. But flow can be generated by any means. In the body, for example, it will be more convenient to use a tube carrying fluids."

The researchers in the UC Irvine experiments used a laser tweezers system to trap a birefringent particle (Calcite or Vaterite) near axonal growth cones, which are the tips of neurons where connections are made with other neurons or cells. The same laser causes rotation of the particle, which creates the flow, Mohanty said.

The paper reports that the new method successfully turned the growing axon in a new direction up to 42 percent of the time in lab experiments. The authors noted that the method could also be used to funnel growth between two rotating particles. The effects also may be reproducible on a larger scale, they said.

"One can envision large arrays of these devices that can direct large numbers of axons to different locations," the authors wrote. "This may have the potential for use in vivo to direct regenerating axons to mediate brain and spinal cord repair."

Mohanty said that during neurogenesis – the process by which neurons grow and develop in a fetus – flow of spinal fluid can influence guidance of neurons to their destinations. His lab at UT Arlington is currently developing a novel optical method that allows long-range optical guidance of neurons with 100 percent efficacy without use of any additional external objects.

In addition to UC Irvine and UT Arlington, other authors on the Nature Photonics study hail from the Quantum Science Laboratory at The University of Queensland in Australia.

The paper said the experiments shed valuable light on the effect of shear or lateral forces on neuron growth and that knowledge may even apply to other forms of cell growth.

More information: www.nature.com/nphoton/journal … photon.2011.287.html

Provided by University of Texas at Arlington

Citation: Physicists 'turn signals' for neuron growth (2011, December 15) retrieved 28 April 2024 from https://phys.org/news/2011-12-physicists-neuron-growth.html