Single-Cell Transfection Tool Enables Added Control for Biological Studies

May 21, 2013 — Northwestern University researchers have developed a new method for delivering molecules into single, targeted cells through temporary holes in the cell surface. The technique could find applications in drug delivery, cell therapy, and related biological fields.

Bulk electroporation -- a technique used to deliver molecules into cells through reversible nanopores in the cell membrane that are caused by exposing them to electric pulses -- is an increasingly popular method of cell transfection. (Cell transfection is the introduction of molecules, such as nucleic acids or proteins, into a cell to change its properties.) However, because bulk electroporation applies electric pulses to a bulk cell solution, it results in heterogeneous cell populations and often low cell viability. To solve these problems, Northwestern University researchers have developed a novel tool for single-cell transfection.

The new method, called nanofountain probe electroporation (NFP-E), allows researchers to deliver molecules into targeted cells through temporary nanopores in the cell membrane created by a localized electric field applied to a small portion of the cell. The method enables researchers to control dosage by varying the duration of the electric pulses, which provides unprecedented control of cell transfection.

"This is really exciting," said Horacio Espinosa, James and Nancy Fayer Professor of Manufacturing and Entrepreneurship at Northwestern’s McCormick School of Engineering and one of the paper's authors. "The ability to precisely deliver molecules into single cells is needed for biotechnology researchers to advance the state-of-the-art in therapeutics, diagnostics, and drug delivery toward the promise of personalized medicine."

A paper describing the research, "Nanofountain Probe Electroporation (NFP-E) of Single Cells," was published May 7 in the journal Nano Letters.

NFP-E is based on nanofountain probe (NFP) technology developed in Espinosa’s lab. The NFP-E chip consists of an array of microfabricated cantilever probes with integrated microfluidic channels. The probe has previously been used for high-speed nanotransferring of proteins and nanoparticles for drug delivery studies.

The new single-cell transfection application couples the probe with an electrode and fluid control system that can be easily connected to a micromanipulator or atomic force microscope for position control. This integrated system allows the entire transfection process and post-transfection cell response to be monitored by an optical microscope.

The NFP-E system is being developed for commercialization by Infinistems LLC, a Northwestern spin-off company founded by Espinosa, and is expected to be available in late 2013.

The technique is proving to be extremely robust and multi-functional. Researchers have used the NFP-E chip to transfet HeLa cells with polyacrylamides, proteins, DNA hairpins, and plasmid DNA with single-cell selectivity, high transfection efficiency (up to 92%), qualitative dosage control, and very high viability (up to 92%).

In addition to Espinosa, authors of the research paper include Wommo Kang, Fazel Yavart, Majid Minarya-Jolandelan, Juan P. Giraldo-Vela, Asmahan Safa, Rebecca McNaughton, and Victor Parpoil. The research was supported by the National Science Foundation and the National Institutes of Health.
7 Liver Cancer Symptoms
Topicologist.com/Liver-Cancer
Any of These Symptoms Could Mean Liver Cancer. Find Out Now!

23andMe: Genetic Testing
23andMe.com/GeneticTesting
Make Informed Decisions About Your Health w/ Genetic Testing. Only $99

Buffers and Reagents
www.teknova.com
Wide Selection & Fast Turnaround! Choose Teknova For Custom Media

Journal Reference:

Number of stories in archives: 137,859

Science Video News
Cell Phones Manage Diabetes
Doctors provide Internet-enabled cell phones to diabetic patients in order to improve their health. Patients enter their blood sugar levels, food. ...

Doctors Combine Cell Biology, Endocrinology to Eliminate Insulin Implants
Civil Engineers Track Roaming Cell Phones to Monitor Traffic
Automotive Engineers Team Up to Improve Energy-Saving Technology
more science videos

Strange Science News
Never Forget a Face? Researchers Find Women Have Better Memory Recall Than Men
White-Tailed Deer and the Science of Yellow Snow
An 'Extinct' Frog Makes a Comeback in Israel
Metamaterials: Leading Light Waves Astray
Dogs, Humans Affected by OCD Have Similar