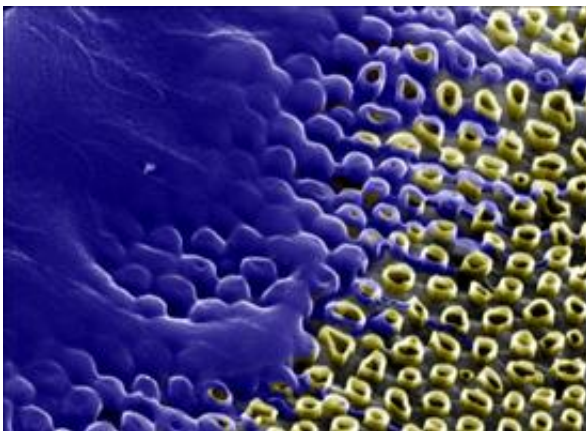


'Honeycomb' of nanotubes could boost genetic engineering

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Electron microscope image of animal cells (colored blue) cultured on an array of carbon nanotubes.

Researchers have developed a new and highly efficient method for gene transfer. The technique, which involves culturing and transfecting cells with genetic material on an array of carbon nanotubes, appears to overcome the limitations of other gene editing technologies.

The device, which is described in a study published today in the journal *Small*, is the product of a collaboration between researchers at the University of Rochester Medical Center (URMC) and the Rochester Institute of Technology (RIT).

"This platform holds the potential to make the [gene transfer](#) process

more robust and decrease toxic effects, while increasing amount and diversity of genetic cargo we can deliver into [cells](#)," said Ian Dickerson, Ph.D., an associate professor in the Department of Neuroscience at the URMC and co-author of the paper.

"This represents a very simple, inexpensive, and efficient process that is well-tolerated by cells and can successfully deliver DNA into tens of thousands of cells simultaneously," said Michael Schlau, Ph.D., an assistant professor in the Kate Gleason College of Engineering at RIT and co-author of the paper.

Gene transfer therapies have long held great promise in medicine. New gene editing techniques, such as CRISPR-Cas9, now enable researchers to precisely target segments of genetic code giving rise to a range of potential scientific and medical applications from fixing genetic defects, to manipulating [stem cells](#), to reengineering [immune cells](#) to fight infection and cancer.

Scientists currently employ several different methods to insert new genetic instructions into cells, including creating small holes in the cell membrane using electrical pulses, injecting DNA into cells using a device called a "gene gun," and employing viruses to "infect" cells with new genetic code.

However, all of these methods tend to suffer from two fundamental problems. First, these processes can be highly toxic, leaving scientists with too few [healthy cells](#) to work with. And second, these methods are restricted in the amount of genetic information - or "payload" - they can deliver into the cells, limiting their application. These techniques can also be time consuming and expensive.

The new device described in the study was fabricated in the Schlau Nano-Bio Interface Laboratory at RIT by Masoud Golshadi, Ph.D. Using

a process called chemical vapor deposition, the researchers created a structure akin to a honeycomb consisting of millions of densely packed carbo nanotubes with openings on both sides of a thin disk shaped membrane.

The device was employed in the Dickerson Lab at URMIC to culture a series of different human and [animal cells](#). After 48 hours, the cells were bathed in a medium that contained liquid DNA. The carbon nanotubes acted as conduits drawing the [genetic material](#) into the cells. Using this method, the researchers observed that 98 percent of the cells survived and 85 percent were successfully transfected with the new genetic material.

The mechanism of DNA transfer is still under investigation, but the researchers suspect it may be via a process called enhanced endocytosis, a method by which cells transfer bundles of proteins back and forth through the cell membrane.

The device has also shown the ability to successfully culture a wide range of cell types, including cells that are typically difficult to grow and keep alive, such as immune cells, stem cells, and neurons.

The researchers are now optimizing the technology in hopes that the device - which is inexpensive to produce - can be made available to researchers and, ultimately, used to develop new treatments for a range of diseases.

More information: High-Efficiency Gene Transfection of Cells through Carbon Nanotube Arrays, [DOI: 10.1002/sml.201503878](https://doi.org/10.1002/sml.201503878), [onlinelibrary.wiley.com/doi/10 ... /sml.201503878/full](https://onlinelibrary.wiley.com/doi/10.1002/sml.201503878/full)

Provided by University of Rochester Medical Center

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