Researchers find faster way to produce efficient nano-vehicles for gene delivery

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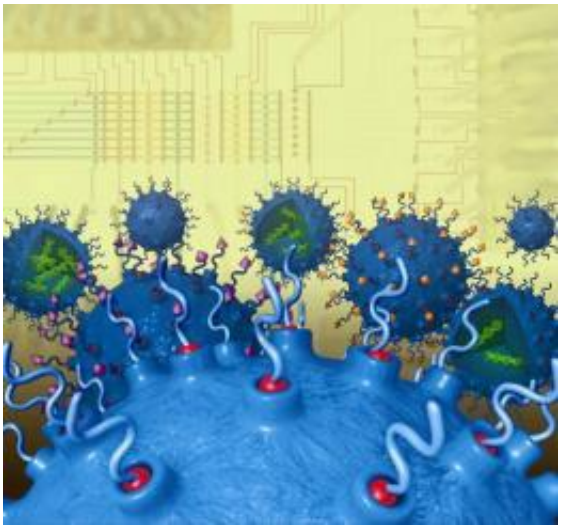

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(PhysOrg.com) -- New stamp-sized microchip enables faster production of low-cost, highly efficient nano-vehicles for gene-delivery.

Gene therapy holds the promise for curing a variety of diseases, including cancer, and nanoparticles have been recognized as promising vehicles for effective and safe delivery of genes into specific type of cells or tissues. This can provide an alternative gene manipulation and/or therapy strategy to the conventional approaches that use viruses.

However, the existing process available for producing and examining nanoparticles for this purpose is limited due to the use of conventional synthetic approaches that are cumbersome and time-consuming. Additionally, the conventional approaches are frequently not sufficient to generate productive outcomes that meet the complex need in biology, in this case, optimal gene-delivery performance.

In an effort to overcome this issue, UCLA researchers from the California NanoSystems Institute and the Crump Institute for Molecular Imaging have established a faster way of producing highly efficient nano-vehicles for gene delivery. The research team developed a supramolecular synthetic approach to produce a library of nanoparticles for gene delivery by simply mixing several molecular building blocks and DNA payloads (without the use of complicated/multi-step synthesis). In order to streamline the process, a digital dual core microreactor (DCM), or microchip, was designed and fabricated for producing and examining the library of artificial viruses in search of an optimal gene delivery performance.

In a paper featured on the cover of the October issue of ACS Nano, the research team outlines their results, which represent a proof-of-concept demonstration for establishing the new method to perform bioassays that are typically conducted to measure the effects of a substance on a living organism and are essential in the development of new drugs.

“We envision that our new approach can be adopted for generating nanoparticle-based vehicles to deliver a variety of cargos, including different genes, siRNA, proteins, drugs, as well as any combination of these elements,” said Professor Hsian-Rong Tseng, an associate professor of molecular and medical pharmacology and member of CNSI and Crump.

“Unlike the conventional methods based manual operations, the UCLA

microchip is specifically designed to avoid human error, accelerate handling procedures, enhance reproducibility and achieve economical use of samples," said Dr. Hao Wang, a staff research associate in Dr. Tseng's research laboratory and the lead author of this paper. "It allows automated formulation of a large-scale library consisting of up to 648 different DNA-containing nanoparticles within 2.5 hours."

Over the past six years, Tseng's research group has pioneered the exploration of digital microfluidics for sequential and parallel chemical reactions. Digital microfludics is an alternative technology for lab-on-a-chip systems based upon micromanipulation of isolated droplets.

The research team is currently exploring the use of these highly efficient nano-vehicles for delivery of genes that facilitate the reprogramming of human cells in order to generate induced pluripotent stem cells (iPSCs) which are crucial in the field of regenerative medicine.

Led by professor Tseng, the UCLA team collaborated with researchers from the Center for Nanoscience and Nanotechnology at Wuhan Textile University, China and the University of Texas Health Center in Houston, Texas. The research was supported by NIH-NCI NanoSystems Biology Cancer Center and California Institute of Regenerative Medicine.

More information: The paper is available online pubs.acs.org/doi/full/10.1021/nn101908e

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