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Nanofountain Delivers Therapeutic Particles Into Cells

Researchers at Northwestern University used a novel tool called Nanofountain Probe to inject tiny diamonds into individual cells. The technology opens up the potential of studying new tumor treatment therapies and how they effect unique cells, and may as well lead to clinical devices that take advantage of the nanotechnology.

From Northwestern:

The group also used the same Nanofountain Probes to pattern dot arrays of drug-coated nanodiamonds directly on glass substrates. The production of these dot arrays, with dots that can be made smaller than 100 nanometers in diameter, provides the proof of concept by which to manufacture devices that will deliver these nanomaterials within the body.

The work addresses two major challenges in the development and clinical application of nanomaterial-mediated drug-delivery schemes: dosage control and high spatial resolution.

In fundamental research and development, biologists are typically constrained to studying the effects of a drug on an entire cell population because it is difficult to deliver them to a single cell. To address this issue, the team used the Nanofountain Probe to target and inject single cells with a dose of.
nanodiamonds.

"This allows us to deliver a precise dose to one cell and observe its response relative to its neighbors," Ho [Dean Ho, assistant professor of mechanical and biomedical engineering] says. "This will allow us to investigate the ultimate efficacy of novel treatment strategies via a spectrum of internalization mechanisms."

Beyond the broad research focused on developing these drug-delivery schemes, manufacturing devices to execute the delivery will require the ability to precisely place doses of drug-coated nanomaterials. Ho and colleagues previously developed a polymer patch that could be used to deliver chemotherapy drugs locally to sites where cancerous tumors have been removed. This patch is embedded with a layer of drug-coated nanodiamonds, which moderate the release of the drug. The patch is capable of controlled and sustained low levels of release over a period of months, reducing the need for chemotherapy following the removal of a tumor.

"An attractive enhancement will be to use the Nanofountain Probe to replace the continuous drug-nanodiamond films currently used in these devices with patterned arrays composed of multiple drugs," Ho says. "This allows high-fidelity spatial tuning of dosing in intelligent devices for comprehensive treatment."

"One of the most significant aspects of this work is the Nanofountain Probe's ability to deliver nanomaterials coated with a broad range of drugs and other biological agents," Espinosa [Horacio Espinosa, professor of mechanical engineering] says. "The injection technique is currently being explored for delivery of a wide variety of bio-agents, including DNA, viruses and other therapeutically relevant materials."

Press release: New Tool For Next-generation Cancer Treatments Using Nanodiamonds

Abstract in journal Small: Nanofountain-Probe-Based High-Resolution Patterning and Single-Cell Injection of Functionalized Nanodiamonds

Image: NFP (nano fountain probe) chips on a wafer, Cantilevers and Apertured tip of an NFP
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By: John D. Quaintman

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