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Precision Medicine: NTU's Breakthrough in Microdroplet Tech

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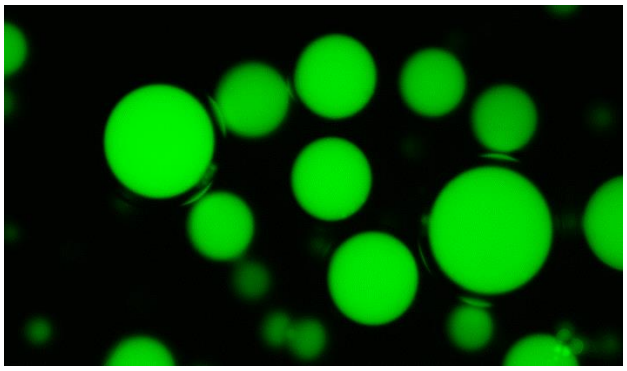
A groundbreaking advancement in medical technology has emerged from the labs of Nanyang Technological University, Singapore (NTU Singapore), as researchers unveil microdroplets capable of detecting disease biomarkers and offering precise light-activated therapy. Led by Nanyang Assistant Professor Chen Yu-Cheng and research fellow Dr. Fang Guocheng from NTU's School of Electrical and Electronic Engineering, this innovative development marks a significant stride in the quest for more accurate disease diagnosis and targeted therapy.



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At the core of this breakthrough lies the creation of minuscule microdroplets, approximately one-third the diameter of a human hair. These droplets, when activated by laser light, exhibit a remarkable ability to detect viral protein biomarkers indicative of various diseases, including cancerous cells. Coated with antibodies that react to specific proteins, these microdroplets act as highly sensitive detectors, capable of identifying particles shed by cells, known as exosomes, which serve as critical disease markers.

The unique aspect of these microdroplets is their ability to serve as focal points for laser light. Upon interaction with the laser, the energy and light within the droplet intensify through repeated reflections, resulting in a more robust energy signal. This amplified signal facilitates the precise detection of wavelength shifts, enabling researchers to identify biological changes associated with diseases such as neurological disorders, genetic anomalies, and cancer.

Assistant Professor Chen elaborates, “Laser activation amplifies subtle biological changes, offering superior performance even in challenging environments like deep tissues. The coherence and intensity of lasers provide a high signal-to-noise ratio, enhancing detection accuracy.”

Beyond disease detection, these microdroplets hold promise in various applications, including drug screening and organ-on-chip technologies. Their adaptability in motion and detection, coupled with biodegradability, renders them suitable for navigating biological environments. Moreover, their compatibility with magnetic particles and surfactants allows for precise control and autonomous movement within the body.

Dr. Fang emphasises the precision and clarity afforded by laser-based detection methods, stating, “Compared to conventional fluorescence tests, laser-based detection offers greater precision, with minimal noise and uncertainty.”

In addition to disease detection, the microdroplets present an innovative approach to photodynamic therapy, a treatment modality that uses light-activated drugs to target abnormal cells. By incorporating photosensitizers into the microdroplets, researchers aim to enhance therapy precision and efficiency. These microdroplets, capable of traversing the bloodstream and binding to exosomes, offer a targeted delivery mechanism for light-activated drugs, minimising collateral damage to healthy tissues.

Dr. Fang envisions the potential of this therapy, stating, “Using lasers as the light source enables precise and localised drug activation, enhancing targeted efficiency.”

The research team is actively pursuing the development of an integrated biochip, poised to revolutionise drug screening and bio-assays. This biochip, leveraging the capabilities of laser-activated microdroplets, holds promise for commercialisation, offering a comprehensive platform for disease diagnosis and therapy on a single chip.

As the medical landscape evolves with technological innovations, the convergence of photonics and biomedicine heralds a new era of precision medicine. With their pioneering work, the researchers at NTU Singapore exemplify the transformative potential of interdisciplinary research in addressing healthcare challenges and advancing patient care.

OpenGov Asia reported that an NTU team has drawn inspiration from nature’s self-assembly phenomenon, particularly the proteins found in Asian corn borer moth caterpillars’ cuticles, to pioneer a revolutionary drug delivery system.

This breakthrough not only revolutionises drug delivery but also showcases the potential of biomimicry in advancing scientific frontiers, merging biology, materials science, and engineering for transformative impacts on healthcare.

Nanyang Technological University (NTU) is at the forefront of transforming healthcare through the deployment of cutting-edge digital solutions aimed at enhancing patient outcomes. Leveraging advancements in technology, NTU is pioneering the integration of artificial intelligence, data analytics, and remote monitoring systems into healthcare practices.

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