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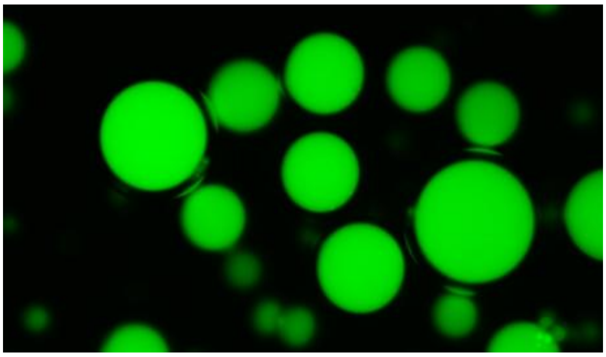
Microdroplets harness laser light to detect disease markers

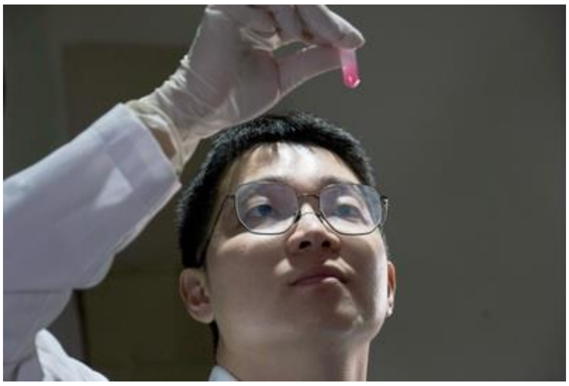


A research team led by Nanyang Technological University, Singapore (NTU Singapore) has created tiny droplets that can detect viral protein biomarkers, indicating the presence of certain diseases, when activated by laser light. The droplets, which measure about one-third the diameter of a strand of human hair, have been described in the journal *Nano Letters*.

The team used a liquid crystal to create microdroplets which were then coated with various antibodies that react to different proteins shed by viruses, turning them into disease detectors. The microdroplet serves as a focal point for laser light — when the laser enters the droplet, its energy and light are amplified as the laser reflects and bounces inside the droplet repeatedly before exiting the droplet. This creates a stronger energy signal that is emitted from the droplet, leading to more accurate, precise and easily detectable signals.

When a microdroplet encounters a protein that reacts with one of its attached antibodies — suggesting the presence of disease or infection — the wavelength of the light reflected out of the microdroplet changes. By measuring the wavelength shift as it leaves the microdroplet, researchers used the technology to detect neurological disorders, genetic diseases and cancerous cells in lab trials.

"Using lasers allows us to amplify subtle biological changes, as they perform well even in scattered or deep tissue environments," said Assistant Professor Chen Yu-Cheng, who co-led the research team. "Lasers offer strong coherence and intensity and a high signal-to-noise ratio, all of which lead to more precise detection."



Dr Fang Guocheng with a vial of laser-activated microdroplets (pink), which are coated with various antibodies that react to different proteins shed by viruses. Image credit: NTU Singapore.

Currently, tests for diseased cells are done with conventional fluorescent light. Using a laser confers several advantages, the biggest being greater precision in detecting diseases.

“As the wavelength of a laser-reflected beam occupies a narrower band than the fluorescence used in conventional tests, the results are clearer and more precise, with less noise and uncertainty,” said the co-leader of the research team, Dr Fang Guocheng.

“Due to their high sensitivity to changes in the surrounding environment, laser particles have been employed as molecular sensors in various applications,” Chen added.

The customisable microdroplets also offer flexibility in motion and detection. They can be manually controlled using magnetic particles or move autonomously using lipids and surfactants, allowing them to spread within the body. They are also biodegradable and can be safely absorbed by the body.

The microdroplets could be applied in photodynamic therapy, where patients receive a light-activated drug (called a photosensitiser) designed to be absorbed by diseased cells. Conventional photodynamic therapy uses an external fluorescent light to activate drug carriers in the bloodstream, by shining light over a large surface area of the body, but such drugs could be activated more precisely and locally by using a laser as the light source instead.

The microdroplets could also be used to deliver photosensitisers to areas where diseased cells shed particles known as exosomes, which function as disease biomarkers. They also have potential applications in drug screening.

“We envision the proposed study can serve as a useful tool for both fundamental biological science and applications such as drug screening and organ or tissue-on-chip applications,” Chen said. The researchers are currently working to develop an integrated biochip which can potentially be commercialised for use in drug screening and bio-assays on a single chip.

https://www.labonline.com.au/content/lab-equipment/news/microdroplets-harness-laser-light-to-detect-disease-markers-1224965454