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Raman tweezers probe living cells

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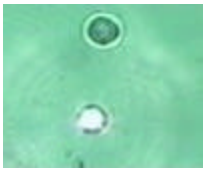
For the first time, Raman spectroscopy is combined with optical tweezers to study living cells.


Tweezing setup

Scientists in the US have made the first study of living cells using a combined laser tweezers and Raman spectroscopy (LTRS) system. The team, from East Carolina University, claims the compact diode-laser-based system may become a valuable tool for studying and diagnosing disorders within living cells (*Optics Letters* **27** 249).

By trapping a cell and then performing Raman spectroscopy in real-time, the team has successfully characterized red blood cells and distinguished between living and dead yeast cells. Researcher leader Yong-Qing Li said: "We believe this is the first study of a single biological cell by use of Raman spectroscopy in an optical trap."

The LTRS system uses a low-power diode laser emitting at 785 nm for both optical trapping and for Raman excitation. Operating in a so-called "power-switching scheme", the diode laser traps the particle using approximately 2 mW.


Red blood cell

The power is then increased to 20 mW for typically two seconds while a Raman spectrum is recorded. After this, the laser returns to low-power operation for trapping.

Li told *Optics.org* that "there are no restrictions on the type of cell that the LTRS system can study. As well as other biological cells, we are now studying E. Coli bacteria and human breast cancer cells in our lab".

A spectrograph equipped with a cooled CCD collects the Raman emission (the backscattered light from the cell) while a video camera system records images of the trapped particles or cells. "For effective excitation, the size of the cell should be comparable to the size of the laser trap,

approximately 2 µm," said Li.

The researchers say that they can trap larger cells, but in these cases only a part of the cell can be excited and analyzed using the current system.

The team now plans to miniaturize the system and then commercialize it. "Using a high-resolution miniature CCD spectrograph, we expect to substantially reduce the size of the current system. Our plan is to make the unit portable and user-friendly, suitable for commercialization" explained Li.

Li and colleagues also plan to study the dynamic processes in a single trapped living cell during its cell cycle. They hope to find new applications in detecting and identifying biological agents, to aid clinical diagnosis and therapy.

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