OPTICS TT02-011YL

Office of Technology Transfer

Product Development Opportunity

EAST CAROLINA UNIVERSITY

Laser Tweezers and Raman Spectroscopy (LTRS)

This innovative combination of Laser Tweezers and Raman Spectroscopy (LTRS) now makes it possible to use one low-powered diode laser for both trapping and Raman excitation in the study of cellular processes and the diagnosis of cellular disorder. The near infra-red wavelength and power-switching operational design allow real-time Raman measurement without damaging the living cell. East Carolina University seeks to commercialize and develop additional applications of this technology.

Commercial Applications

- detect and identify biological organisms
- aid in bio-terrorism defense
- provide rapid and reliable clinical diagnosis
- monitor and detect water or air quality on-site
- aid research in molecular and cellular biology

Benefits

- low cost, high sensitivity, capable of miniturization
- incorporates simple, user-friendly features
- provides real-time Raman measurement
- allows for the study of biochemical change
- allows for capture and manipulation of biological cells and micron-sized particles in fluid

Key Words

- optical tweezers
- raman spectroscopy
- diode laser

The Technology

A compact LTRS system combines the advantages of NIR Raman spectroscopy and optical tweezers for the characterization of single biological cells with a low-power semi-conductor laser. The laser power-switching technique allows low-power trapping (~2.0 mW) and high-power Raman excitation (~20 mW) of biological cells. In the laboratory, single red blood cells and yeast cells have been trapped and recorded with the LTRS system, and noticable differences in the Raman spectra of living and dead yeast cells were demonstrated. Using this system, molecular information from in vitro single biological cells can be obtained and used to understand the fundamental cell processes and to diagnose cellular disorder.

Figure 1: Experimental Set-Up

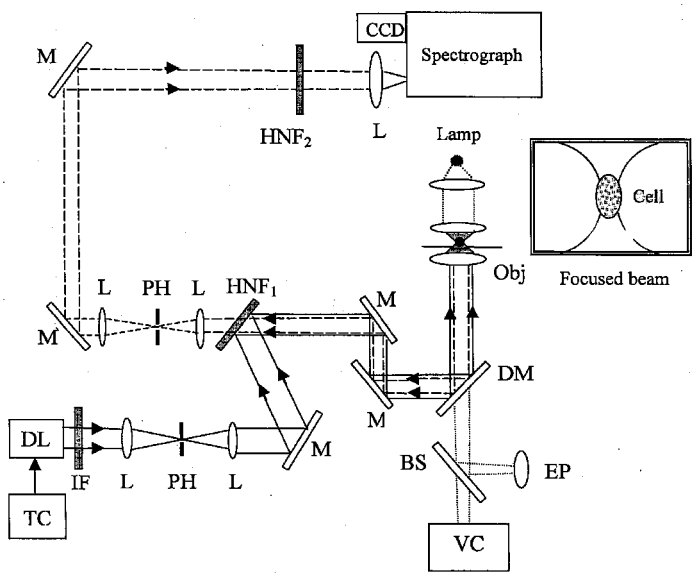

figure 1. Experimental setup. A diode laser (DL) beam passes through an interference filter (IF), a pinhole (PH) and is then introduced into an inverted microscope through a dichroic miror (DM) to form an optical trap. The Raman scattering light of the trapped particles is collected with the same objective, passes through a holographic notch filter (HNF1) and a pinhole (PH), and is then focused onto the entrance of an imaging spectrograph equipped with a CCD detector. M -reflection mirror; L-lens; BS -beam splitter; Obj -objective lens; EP-eyepiece; VC -video camera; TC -Temperature controller; Lamp -Green-filtered xenon illumination light.

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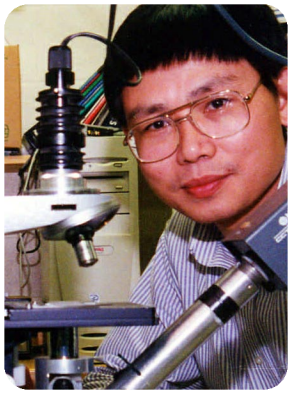
About the Inventors



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1. C.A. Xie and Y.Q. Li, "Confocal micro-Raman spectroscopy of single biological cells using optical trapping and shifted excitation difference techniques", Journal of Applied Physics, 93, 2982-2986 (2003).
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3. Y.Q. Li, D. Guzun, and M. Xiao, "Sub-shot noise optical heterodyne detection using amplitude-squeezed light as local oscillator", Physical Review Letters, 82, 5225-5228 (1999).
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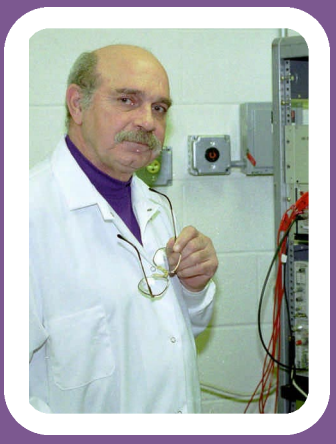

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1. C.A. Xie, M. A. Dinno, and Y.Q. Li, "Near-infrared Raman spectroscopy of single optically trapped biological cells", Optics Letters, 27, 249-251 (2002).

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Laser Tweezers & Raman Spectroscopy (LTRS)

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