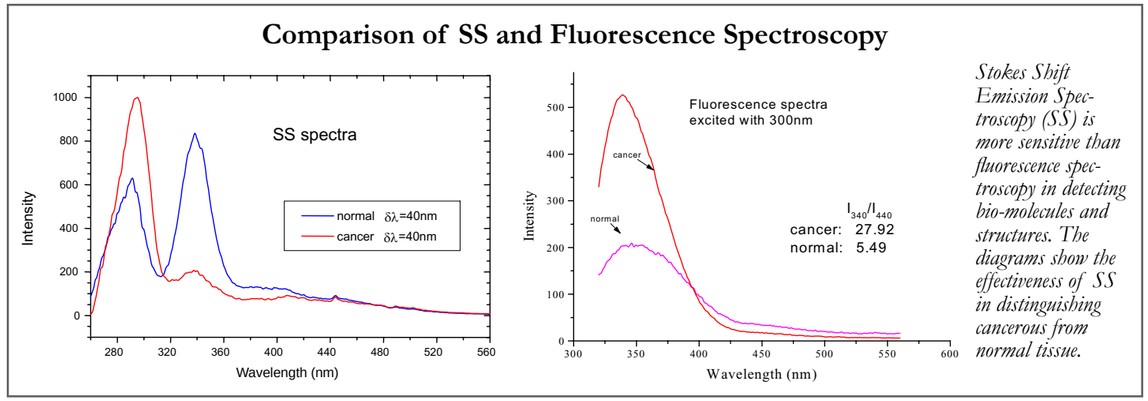

Stokes Shift Emission Spectroscopy (SS) is more sensitive than fluorescence spectroscopy in detecting bio-molecules and structures. The diagrams show the effectiveness of SS in distinguishing cancerous from normal tissue.

RESEARCH BREAKTHROUGHS *Continued from page 3*

• **Detecting Cancerous Tissue Via Stokes Shift Emission Spectroscopy.** A new diagnostic technique called Stokes Shift Emission Spectroscopy is much more sensitive than conventional fluorescence spectroscopy to detect cancerous bio-molecules and structures. This research breakthrough offers the potential to make optical biopsy the new medical frontier for cancer diagnosis and other medical applications. For organic molecules, typically, the peaks of absorption and emission occur at different wavelengths and the emission band occurs at lower energy than the excitation band. This difference between the emission and absorption peaks, known as the Stokes Shift, depends in part on the polarity of the host environment surrounding the emitting organic molecule and vibrational coupling strength. The new detection method combines the fluorescence and absorption spectra of molecules in tissue. The excitation and emission wavelengths are scanned simultaneously with a fixed value between the excitation and emission wavelengths. This approach is much more sensitive than ordinary fluorescence spectroscopy and has delivered dramatically improved results in detecting changes in native bio-molecules. It offers great promise, therefore, in detecting tumors involving the cervix, gastrointestinal tract, head and neck and other organs. This research builds upon earlier optical biopsy projects supported by Mediscience Technology Corporation.

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NEW CD-ROM *Continued from page 1*

Biomedical Optical Biopsy is an especially valuable resource for undergraduate and graduate students who are embarking on research involving optical biopsy, as well as for scientists, engineers and physicians in the field.

The CD-ROM is fully searchable by subject, keyword or author's name. In addition to reprinted papers ***Biomedical Optical Biopsy*** contains lists of patents, books on optical biopsy, journals, resources for manuscript preparation and other useful information.

Among the numerous subject areas covered in ***Biomedical Optical Biopsy*** are the following: Fluorescence Biopsy, Raman Biopsy Techniques, Time-Resolved Techniques, Optical Coherence Reflectometry and Tomography, Confocal Microscopy, and Nonlinear Optical Imaging Techniques such as Second Harmonic Generation and Multiphoton Excitation.

Dr. Alfano is Distinguished Professor of Science and Engineering at CCNY. His co-editor is Dr. Barry Masters, a leading authority on multi-photon imaging.

"***Biomedical Optical Biopsy*** offers a host of outstanding papers from the beginning of the field to the present by a wide-range of authors in a convenient, compact, easily searchable form," Dr. Alfano said.

The papers were selected on the basis of the innovative quality of the experimental or theoretical work, their educational value and their impact on the field.

"Papers were chosen because of their contributions in one or more of the following areas: pioneering work; sources of data; experimental method, and design technique," Dr. Alfano added.

The new CD-ROM will be especially useful to those who are interested in the field and want a guided tour through emerging areas of research.

To order the CD-ROM ***Biomedical Optical Biopsy*** from the Optical Society of America please go to www.osa.org/pubs/bookstore2

Editor: Charles DeCicco. Designer: Lauren Gohara

The IUSL Report

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Research Breakthroughs at CUNY-CAT Bring Product Development Opportunities for New York State Companies

Research breakthroughs at The New York State Center for Advanced Technology in Ultrafast Photonics at The City University of New York (CUNY-CAT) have resulted in a number of new technical opportunities for New York State companies in the photonics and biomedical and homeland defense fields.

According to Dr. Robert R. Alfano, Director of CUNY-CAT, "this research offers major product development opportunities for companies in New York State that are operating in the diverse fields. Companies like Lockheed-Martin, Grumman, Quantronix and Mediscience Technology Corporation have benefited from our relationship for corrosion and bacteria detection, laser development and cancer diagnostics."

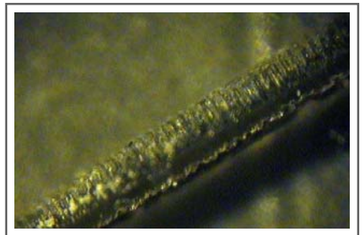
Dr. Alfano is Distinguished Professor of Science and Engineering at The City College of New York/CUNY.

Established in 1993, CUNY-CAT promotes economic development in the State by generating and disseminating knowledge in photonics technology. It is supported by the New York State Office of Science, Technology and Academic Research (NYSTAR); industry partners; and The City University of New York. The Center is headquartered at City College, with staff, facilities and equipment available on five CUNY senior college campuses. Approximately 20 faculty members from the University's science and engineering departments are affiliated with CUNY-CAT.

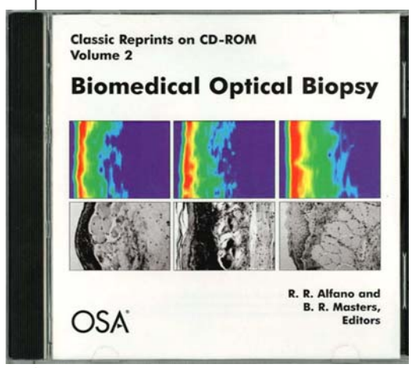
The latest research breakthroughs that offer New York State companies the opportunity to expand their horizons include the following:

• **A Fiber Optic Biohazard Sensor that can be used to detect chemical and biological agents, as well as conventional explosives and radioactive agents.** Built into cargo containers and truck trailers or retrofitted into existing units, these sensors offer rapid, noninvasive analytical triage of the contents. They are a revolutionary method to deal with the major security problem presented by the vast number of containerized cargo units and truck trailers that enter the U.S. daily.

Continued on page 2



Fiber Optic Biohazard Sensor.



New CD-ROM From Optical Society of America Offers Comprehensive Collection of Papers on Biomedical Optical Biopsy

Dr. Robert R. Alfano, Director of City College's Institute for Ultrafast Spectroscopy and Lasers, is the senior editor of a new CD-ROM entitled ***Biomedical Optical Biopsy*** that was released recently by the Optical Society of America (OSA). The CD-ROM is an important collection of over 300 classic articles from the earliest to the most recent on the subject of optical biopsy.

Optical biopsy involves the use of light and photonic technology to diagnose cancer without removing tissue from the body. It replaces invasive cancer detection techniques to determine its extent and assist in surgery and diagnostics.

Continued on page 4

Continued from page 1

- **An Ultrafast Terahertz Diode that is a major advance over the classic semiconductor diode that is one of the main elements of semiconductor electronics.** The high-speed device is expected to have picosecond response times, along with the ability to switch off abruptly. It is also insensitive to external radiation, which is particularly important in time sensitive applications such as test equipment (high speed oscilloscopes, transient recorders), super-computers, radar and time-resolved spectroscopy.

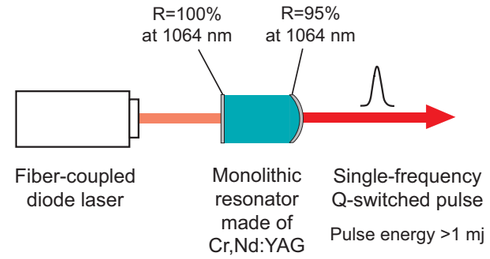
- **An RNA MicroChip to Detect Biological Pathogens.** This technology is an ideal approach for pathogen detection in biodefense as well as for detecting microbial contamination in food, air and water supplies. The technology, which is simple to implement, is rapid, accurate and sensitive. It is also cost-effective, simplifies sample handing and reduces the costs of reagents and the need for special instruments.

- **Compact High-Power Single-Frequency Monolithic Q-Switched Laser.** This device generates intense, single-frequency laser pulses in a transform-limited spectral linewidth-pulse duration product. The pulse energy is on the order of millijoules and can be scaled up with increasing volume. The typical peak power is on the order of megawatts, while pulse duration is on the order of nanoseconds. Applications include high-resolution laser spectroscopy, ranging, harmonic generation, pulsed injection seeding and micro-machining.

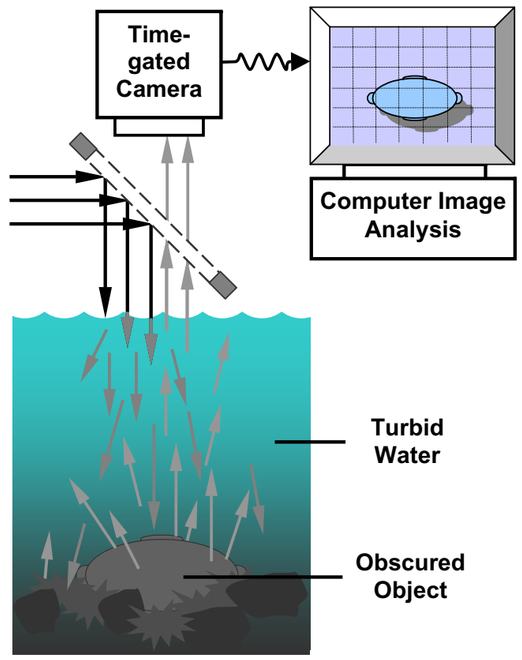
- **Compact Real-Time Fourier-Transform Spectrometer Without Moving Parts.** This project aims to develop a compact, low-cost real-time Fourier-transform spectrometer for fast detection and characterization of chemicals in rapidly changing and/or fast moving environments, such as chemicals in clouds and vapor. Miniature and lightweight, it has no moving parts, wide spectral converge, operates over the range from UV to mid-infrared, can function in rapidly changing environments and features an enclosed, stand-alone, real-time digitizing spectrometer.

- **Underwater Optical Imaging.** This technology utilizes ultrafast time-gated and polarization-sensitive techniques for imaging targets that are obscured or hidden in shallow turbid (murky) water. It promises to be extremely effective in locating underwater objects such as mines. This project is part of other ongoing efforts at the CUNY-CAT that include research to resolve imaging problems through atmospheric conditions such as clouds and fog. Several patents have been issued or are pending which may be available for licensing.

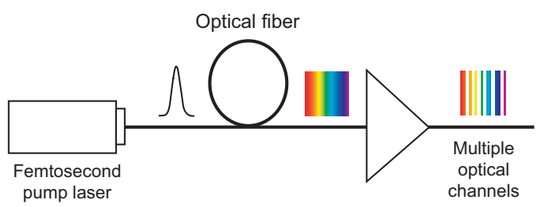
- **A Supercontinuum Source for Multiple Communication Channels.** The Supercontinuum (SC) is a broad wavelength band source which has been shown to have superior advantages for background free and high-bit rate optical fiber communication. Discovered by Dr. Robert R. Alfano in the early 1970's, SC generation is an effective way to obtain a large number of wavelength channels because it can easily generate more than 100 optical modes while maintaining their coherency. Potential applications include single-source WDM optical communication systems, optical frequency generator computer timing, high-resolution spectroscopy and metrology.



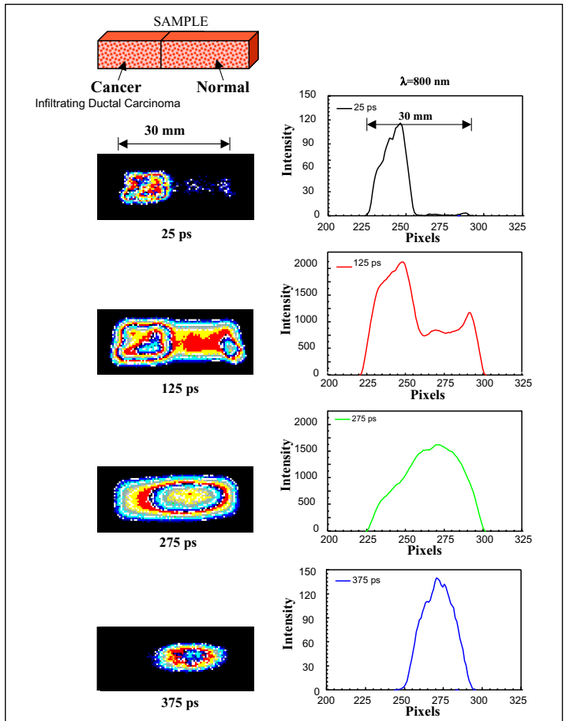
Compact High-Power Single-Frequency Monolithic Q-Switched Laser.



Mine Detection in Turbid or Milky Water.



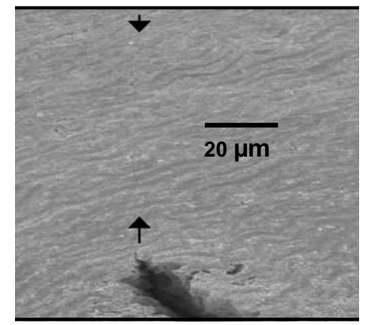
Basic Configuration of the Supercontinuum Multiple Channel Source.



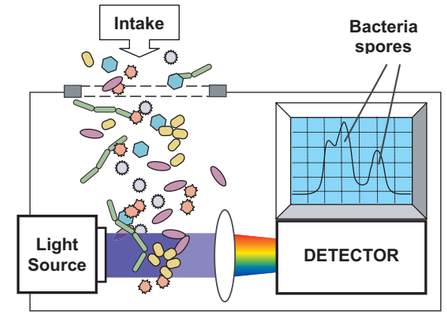
Time-sliced images of a breast tissue sample with infiltrating ductal carcinoma.

- **Tissue Welding With Near Infrared Laser.** Laser tissue welding is a revolutionary technique for wound closure. It has potential applications in virtually all surgical specialties and its numerous advantages include: little or no scarring, rapid healing, water-tight sealing and no susceptibility to foreign body reaction. In addition, no foreign material is left behind after closure of the wound, and no "solder" or dye are required. Using Near Infrared Light in water absorption bands makes CUNY-CAT's tunable laser technology unique in the 1100 to 1500 nm range. Welded tissue are over twice as strong in bonding than sutures after the sutures are removed.

- **Optical Mammography and Tomography.** This non-invasive method uses non-ionizing near infrared (NIR) light to obtain three-dimensional images of the interior of the breast. Time-resolved, space-gated and polarization sensitive imaging techniques have been developed that can differentiate between tumor and normal tissue. Early detection and diagnosis of breast cancer is essential for effective treatment. X-ray mammography, the current modality for breast cancer screening, cannot distinguish between malignant and benign tumors, and is less effective for younger women with dense fibrous breasts. Therefore, if a tumor is suspected from an x-ray mammogram, a biopsy that requires invasive removal of tissue from the suspect region must be performed to determine if the tumor is benign or malignant. Patients must also wait an agonizing period until the biopsy results are known, and in the majority of cases the biopsy is negative. Optical Mammography and Tomography, therefore, offers the promise of a breast cancer screening method that is fast, accurate and does not require tissue removal.



A scanning electron micrograph of a specimen of welded porcine arterial tissue. The quality of the weld is so extraordinary that under a 480x SEM magnification, little difference is observed between the welded region (between the arrows) and the normal region.



Simplified drawing of Photonics-Based Detection Device for Biohazards and Bio-Defense.

- **Photonic Detection System for Biohazards and Bio Defense.** This newly patented photonic technology enables rapid *in situ* detection of key fluorescent biological molecules, including various bacteria and other microorganisms. There are indications that the method may also be effective for detecting certain viruses. The patent includes the design of a hand-held device for real-time detection of these materials outside of the laboratory. Potential uses include bioterrorism agent detection, food and water supply safety monitoring, screening of mail and packages, hospital and other medical safety monitoring, and bio-contamination measurements in aircraft and ships.

Continued on page 4