OKLAHOMA STATE UNIVERSITY

The CSST News

THE NEWSLETTER OF THE CENTER FOR SENSORS & SENSOR TECHNOLOGIES

VOLUME 4, ISSUE 1

SPRING 2003

OSU Sensor Research focused on Anti-terrorism even before 9-11

Even before September 11th, more than 40 Oklahoma State University faculty were focusing on antiterrorism research by developing sensors capable of detecting everything from airborne chemical and biological weapons to poisonous food- and waterborne bacteria.

Those efforts will be considerably enhanced by the passage of House Bill 2536 making $38 million in funding available to the University of Oklahoma for weather research and to OSU for sensor research.

The OSU funds will be used to purchase equipment and renovate facilities for work on the application of advanced sensor technology for the detection of chemical and biological threats to homeland security.

The Bush administration and Congress have said they will provide $20 billion for bioterrorism research, and OSU officials want the University positioned to successfully compete for its share of those funds.

According to Dr. J.W. Alexander, interim vice-president for research at OSU, "This funding will provide facilities and equipment to allow OSU faculty to compete on a national level for research funding. It will result in increased federal funding for Oklahoma, significant contributions to homeland security for the nation and high-tech companies and jobs for the state."

OSU President Emeritus James Halligan explains that the University already has more than $7 million in grants to support multiple sensor-related projects, but the $19 million investment has the potential for drawing millions of dollars in federal research funds to Oklahoma.

OSU faculty are working on a wide array of sensors from applications in cancer treatments to improving water quality. Much of the research focuses on antiterrorism research.

Two of the largest projects are supported by the Memorial Institute for the Prevention of Terrorism in Oklahoma City. Dr. Ken Clinkenbeard in Veterinary Medicine is leading a project using ultra-sensitive sensors to sniff out bio-agents from anthrax to food and water contaminants. He is collaborating with Nomadics, Inc., a Stillwater high-tech firm.

Dr. Donna Branson in Human Environmental Sciences is developing a portable battery-powered cooling system that will provide cooling for HAZMAT level A ensembles such as the ones worn by firefighters and rescue workers at Ground Zero in New York City.

Expanding and equipping sophisticated biocontainment labs will allow OSU to rapidly increase its bioterrorism research in the areas of food, water and air safety.

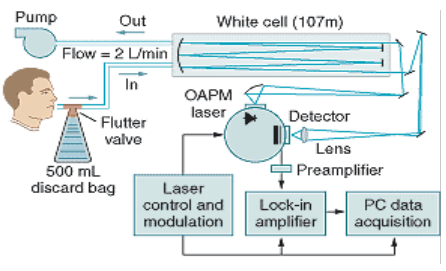
"Our scientists are moving quickly to get these applications ready in months, not years," Halligan says, but our laboratories need to meet a higher standard in order to attract the federal funding that will soon be available."OSU hopes to begin renovations immediately and have the first labs complete later this year.

SENSORS THAT TAKE YOUR BREATH

Researchers Patrick McCann at the University of Oklahoma in Norman and William Potter at the University of Tulsa have developed a sensor based on tunable diode laser (TDL) technology that can be used to assess airway inflammation by measuring nitric oxide (NO) in exhaled breath The collaborative effort also involved Ekips Technologies, a University of Oklahoma spin-off company. Earlier research on measuring NO in breath samples relied on chemiluminescence techniques, which involve reacting ozone with NO in breath samples and measuring generated light with a photomultiplier tube. The TDL sensor, called the Breathmeter by Ekips, improves upon the chemiluminescence method in that no reagent consumables are needed and consistently accurate measurements are obtained for various exhalation flow rates and environmental conditions. These features make the TDL sensor more suitable for routine clinical use.High levels of exhaled NO are known to correlate with airway inflammation, a chronic condition in people who have asthma, so the test offers a new way to diagnose asthma as well as monitor the effectiveness of anti-inflammatory therapy. Clinical trials with the Breathmeter are presently underway at the Lung Center in Norman, OK. This trial follows a pre-clinical trial at the Oklahoma Allergy & Asthma Clinic in Oklahoma City. "Early results with the Breathmeter show it provides consistent exhaled nitric oxide measurements related to airway inflammation -- even when nitric oxide levels in the air vary widely due to factors such as exhaust emissions from cars.The Breathmeter technology will likely prove useful in the diagnosis of asthma, but I'm also focused on how it can improve anti-inflammatory treatment by enabling more accurate dosing and ensuring therapy compliance," says Mark A. Camp. M.D. of The Lung Center . "The potential benefits to both the doctor and the patient are substantial because we have another tool to use in the clinic to help us monitor the progress of asthma therapy. The Breathmeter is a very patient friendly device which allows us to test children too small for standard pulmonary function testing. We are excited about its potential clinical applications," says Warren Filley, M.D. of the Oklahoma Allergy & Asthma Clinic.

An article describing the TDL breath analysis sensor (see image) appeared in the January 2002 issue of Optics Letters (C. Roller, K. Namjou, J. Jeffers, W. Potter, P. J. McCann, and J. Grego, "Simultaneous NO and CO2 Measurements in Human Breath Using a Single IV-VI Mid-Infrared Laser", Optics Letters 27, 107 (2002)). An article describing the technology in more detail appears in the October 2002 issue of Applied Optics.

Tunable Diode Laser Breath Sensor



CENTER FOR SENSORS AND SENSOR TECHNOLOGIES
COLLEGE OF ARTS & SCIENCES

INSIDE THIS ISSUE:

Spotlight on Research

Arthur C. Lucas, President-Nextep Technologies, Inc., Stillwater, OK

On April 30, 2002, Nextep Technologies, Inc. received a government purchase order to design, construct and deliver a radiation detection system that would alert authorities when 20 kg of marijuana passed through it in a vehicle. .

The system is based on the fact that marijuana selectively concentrates potassium, and thereby, radioactive potassium-40. The system will utilize approximately 900 pounds of gamma ray detecting, scintillating plastic and approximately 8 tons of selected, low background, steel shielding. It will alert authorities in as little as 15 seconds after a vehicle containing marijuana passes into the measurement position.

The system will be delivered in early August to evaluation stations in Arizona and California. From there, it will be moved to a permanent border crossing for long-term operation. The evaluation process will determine its applicability to detection of other contraband materials. If the system is successful, as many as 800 border crossing stations could be equipped in this way. The rapid design and construction phases were aided by the experience of the Nextep team, which has spent many years in the design of systems for the detection of low levels of radioactive contaminants. Such systems are commonly used for the determination of radioactive materials present in soils, water and vegetation. In factories processing nuclear materials, they are often used to determine accidental ingestion of radioactivity by workers.

In addition to serving as Nextep president, Lucas is an invited scientist in the Department of Physics at OSU. Nextep is a four-way partnership among Lucas, Dr. Leslie Colyott, a recent OSU physics graduate, and Steve Marshall and Harry Newman, both of Louisville, Kentucky. The company was formed to take advantage of product opportunities which occur in the consulting roles played by the principles in environmental remediation. For more information about the company or its projects, contact Lucas at Alucas0217@aol.com.

Congratulations to. . .

A.T. Rosenberger, Physics and CSST collaborator, on his recent promotion to associate professor.

Dr. Satomi Niwayama, OSU assistant professor of chemistry, recently received the National Science Foundation's highest honor for junior faculty, a $400,000, five-year Faculty Early Career Development (CAREER) grant for exceptionally promising college and university junior faculty who are committed to the integration of research and education and who are most likely to become academic leaders. Dr. Niwayama received a $10,000 seed grant from the CSST two years ago. Niwayama also won the 2000 Morita Science Research Promotion Award, which is presented annually to two female scientists from Japan who are under 40 years of age. In addition, she received the 2002 Banyu Award in Synthetic Organic Chemistry, another award for prominent young researchers from Japan.

2001-02 CSST Seminar Series

- "Quartz Crystals Versus Their Environment: Time Bases or Sensors? (Keeping the World on Time and Your Tanks Full of Gas)," **Errol P. EerNisse**, Quartzdyne, Inc.
- "Widely Tunable Mid-IR Lasers and Their Use in Molecular Spectroscopy," **Patrick J. McCann**, University of Oklahoma, co-sponsored by the CSST and the Department of Physics.

CSST Activities

- **James P. Wicksted**, CSST Director, represented the Center at numerous conferences, on-site visits, tours and presentations throughout the year including International Crystal Manufacturing, OCAST, Legislative Days and Capitol Day, all in Oklahoma City; the FOTC Summit in Tulsa; OTCC Tech Night Out, Sensor Research and Development Corporation and Nomadics, Stillwater.
- The CSST worked jointly with **Drs. Jerry Malayer** and **Ken Clinkenbeard** of the College of Veterinary Medicine in securing $2.1 million in 2003 Congressional Funds for applied research titled "Bioterrorism Defense and Advanced Sensors Research". This effort is a Congressional Add in Program Element that belongs to budget activity 3 within the Chemical Biological Defense Program.

Proposals funded with CSST participation:

T. Wilson, Physics, "Optical Materials, Lasers and Their Applications in Optical Sensing", NSF REU proposal.

- **N. Kotov**, Chemistry, OSU-PI, **J. Wicksted**, Physics, OSU-Co-PI; Main PI **J. Leary &** Main Co-PI **M. Motamedi** & **Drs. Lloyd** and **Dobson**, University of Texas Medical Branch, Galveston), & **Dr. Lvov,** LA Tech, "Nanoparticle Delivery of Repair Enzymes for Radiation Protection/DNA Repair," NASA/NCI program: Fundamental Technologies for Development of Biomolecular Sensors. This proposal is just one of seven selected for funding by the joint NASA/ NCI program from the 53 submitted.
- **N. Kotov**, Chemistry, PI, **J. Wicksted**, Physics, **Warren Ford**, Chemistry; **M. Motamedi**, PI, **J. Leary & B. Christensen**, University of Texas Medical Branch, Galveston, "Photoactivated Coupling of Nanoparticle Multilayers and Nerve Cells," NSF Biophotonics: Collaborative Research. This proposal was ranked #1 among all proposals submitted to this program.
- **N. Kotov**, Chemistry, OSU-PI, **J. Wicksted**, Physics, OSU Co-PI; & Main PI **M. Motamedi**, University of Texas Medical Branch, Galveston, "Opitcal Coherence Tomography for Glucose Sensing," National Medical Testbed.

CSST related Publications,Presentations and Patents:

- **R. Erckens, F. Jongsma, J. Wicksted, F. Hendrikse, W. March** & **M. Motamedi**, "Raman spectroscopy in ophthalmology: From experimental tool to applications in vivo," **Lasers Med. Sci.**, Vol. **16**, 2236-2252 (2001).
- **R. Erckens, W. March, F. Jongsma, J. Wicksted, F. Hendrikse, E. Smit & M. Motamedi**, "Noninvasive Raman spectroscopic identification of the intraocular lens material in the living human eye," **J. Cataract Refract. Surg.,** Vol. **27**, 1065-1069 (2001). A short description of this article also appeared in the Biophotonics News section, pp. 28-30 of the December 2001 issue of **Biophotonics International**.
- **R. J. Erckens, K. Hosseini, W.F. March, F. H. M. Jongsma, J. P. Wicksted, H.K. Li and F. Hendrikse**, "Raman spectroscopy: Noninvasive Determination of Silicone Oil in the Eye. Potential Applications for Intraocular Determination of Biomaterials", Retina-Journal of Retinal and Vitreous Diseases **22**, 796 (2002).
- **Arif A. Mamedov, Nicholas A. Kotov, Maurizio Prato, Dirk M. Guldi, James P. Wicksted, Andreas Hirsch**, "Molecular Design of Strong Single-Wall Carbon Nanotube/Polyelectrolyte Multilayer Composites", Nature Materials **1**, 190 (2002); Nature Materials **1**, 257 (2002).
- **N. Kotov, M. Motamedi, J. Wicksted & R. Esecaliev**, "Implantable Biosensor from Stratified Nanostructured Membranes. Provisional Patent Application Serial No. 60/368,921 filed on 3-29-02. New U.S. Patent Application filed on 3-31-03.
- **B.J.White, J.A.Legako, & H.J.Harmon,** "Reagentless Detection of a Competitive Inhibitor of Immobilized Acetylcholinesterase",Biosensors and Bioelectronics 17,361-366(2002)
- **B.J.White & H.J.Harmon**, "Interaction of Monosulfonate Tetraphenyl Porphyrin,a Competitive Inhibitor, with Acetylcholinesterase", Biosensors and Bioelectronics 17,463-469(2002)
- **B.J.White, J.A.Legako, & H.J.Harmon**, "Extended Lifetime of Reagentless Detector for Multiple Inhibitors of Acetylcholinesterase".Biosensors 2002,Kyoto,Japan.May 15-17,2002.
- **H.J.Harmon,** "Porphyrins as CB Detectors". Proceedings of the First Joint Conference on Point Detection for Chemical and Biological Defense , Williamsburg,VA.October 23-27,2002.

CSST SEED Funding Activities

Since the first CSST Call for Proposals in 1998, 21 proposals have been funded, resulting in almost $180,000 being distributed to researchers in four colleges across campus.

CSST SEED Grants Awarded:

- **Jeffrey Hadwiger**, Microbiology & Molecular Genetics, "Dictyostelium-based Biosensor of Mammalian Signals."
- **Ulrich Melcher**, Biochemistry & Molecular Biology, & **Alexander Lai**, Microbiology & Molecular Genetics, "Multiple Virus Detection Sensors."

Proposals Submitted Related to CSST SEED Funding:

- **S. Niwayama**, Chemistry, "Synthetic Studies of Molecular Libraries for Discovery of Aniogenesis Inhibitors," Cap Cure Foundation.
- **Jeffrey Hadwiger**, Microbiology and Molecular Genetics, "Specificity of G-Protein Signal Transduction Pathways", NSF, 302,565.
- **Jeffrey Hadwiger**, Microbiology and Molecular Genetics, "Specificity of G-Protein Signal Transduction Pathways", OCAST, 135,000.
- **H. James Harmon**, Physics, "Real-Time Detection of Biological Warfare Agents", OCAST, $135,000.
- **S.W.S. McKeever**, Physics, "Advanced Luminescent Radiation Sensor for Bioengineering & Environmental Monitoring, University of Washington, $240,000.
- **Nicholas A. Kotov**, Chemistry, and Nomadics, Inc., "Optical Sensors Based on Nanoparticle Immunoconjugates", Phase II SBIR, NSF, $500,000.
- **Nicholas A. Kotov**, Chemistry, "Preparation of Biocompatible Implantable Biosensors", The University of Texas Medical Branch, Galveston, $341,958
- **A.T. Rosenberger**, Physics, "Sensors: Optical Whispering-Gallery Modes for Diverse Sensing Applications", NSF, $365,178.

Grants Awarded Related to CSST SEED Funding:

- **J. Harmon**, Microbiology & Molecular Genetics; Physics, "Porphyrin –Mediated Photocatalytic Degradation of Energetic Materials," U.S. Army Defense Ammunition Center.
- **J. Harmon,** Physics, Co-PI, "Field Portable Chip-Based Anti-Terrorism Microanalyzer", Oklahoma City National Memorial Institute for the Prevention of Terrorism (**M. Ashok**, PI, University of California, Riverside.
- **N. Kotov**, Chemistry, and **Nomadics, Inc.**, "Optical Sensors Based on Nanoparticle Immunoconjugates," Phase I SBIR, NSF.
- **N. Kotov**, Chemistry, "Biological Sensors made by LBL," CIBA Vision.
- **S. McKeever**, Physics, OSU-PI, system development; **Colorado State University**, Lead PI, system testing in field; **Landauer, Inc**., materials; "Radiation Sensors for Environmental Contamination Monitoring," Department of Energy.
- **A. Rosenberger**, Physics, "Microsphere-Based Evanescent-Wave Optical Sensor," OCAST.
- **A. Rosenberger**, PI, & **D. Bandy**, Physics, Co-PI, & **N. Kotov**, Chemistry, Co-PI, "Whispering-Gallery Microlaser with Nanocomposite-Film Gain Medium, NSF.