

## FLC Northeast Region Newsletter – Spring 2007

### **Northeast Region Laboratories Recognized at 2007 FLC Awards**

Four laboratories from the Northeast Region received 2007 FLC Awards for Excellence in Technology Transfer at a ceremony in Fort Worth, Texas, on May 17. The award recognizes federal laboratories and their partners for successfully transferring federally developed technologies. Twenty-four awards in the category were presented to 21 laboratories representing 5 federal agencies nationwide. The Northeast Region laboratories honored include:

#### ***Plum Island Animal Disease Center – Greenport, NY***

This team developed a technology that bleeds mice humanely for research projects. The Center, affiliated with the Department of Agriculture, created a device that is a 2” strip of surgical steel with a triangular blade that controls penetration depth. Different point lengths accommodate different size mice. The technique has increased the accuracy of experiments that require multiple samples from the same animal. This simple method to draw blood has reduced the suffering of laboratory mice. Internationally, researchers are rapidly adopting this technology and have purchased over a million lancets in less than a year.

**Team members:** Drs. William Golde and Luis Rodriguez, Plum Island Animal Disease Center; Peter Gollobin, MediPoint.

#### ***U.S. Army Research Development and Engineering Command, Natick Soldier Center – Natick, MA***

This team received an award for their technology, a portable chemical sterilizer (PCS). The Natick, Massachusetts-based laboratory created for medics a lightweight, durable, and reusable apparatus that can easily be transported and that conveniently sterilizes contaminated medical equipment without requiring electricity. Beyond the battlefield the PCS can benefit other markets such as community hospitals for emergency backup sterilizer units, and global entities supporting worldwide disaster relief efforts and humanitarian aid in third-world countries.

**Team members:** Dr. Christopher Doona, Florence Feeherry, and Dr. Irwin Taub (deceased), U.S. Army Research Development and Engineering Command, Natick Soldier Center; Drs. Dave Baer and Albert McManus, U.S Army Medical Research and Materiel Command, Institute of Surgical Research.

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### Northeast Region Laboratories (cont.)

#### ***John A. Volpe National Transportation Systems Center – Cambridge, MA***

This team developed crash energy management (CEM) passenger rail equipment, which will improve the safety of cab car-led passenger trains in the event of collisions with locomotive-led trains. CEM improves crashworthiness with crush zones designed to collapse in a controlled fashion during a collision, distributing the crush among the unoccupied areas of the train. New rail equipment with the CEM features is expected to be in service in 2009.

**Team members:** Michael Carolan, Karina Jacobsen, Daniel Parent, A. Benjamin Perlman, Michelle Priante, Kristine Severson, and David Tyrell, John A. Volpe National Transportation Systems Center; Charlie Bielitz, Grady Cothen, Cindy Gross, Eloy Martinez, Gunars Spons, Jo Strang, and Tom Tsai, Federal Railroad Administration.

#### ***Naval Undersea Warfare Center, Division Newport – Newport, RI***

The members of this team were honored for development of the Blue Rose Fiber Optic Perimeter Security and Detection System. Blue Rose detects an intruder via changes in the buried optical fiber caused by sound waves in the ground. The system alerts the operator with an audio alarm as well as a visual display of the location of the intrusion along the perimeter. An integrated camera system utilizes GPS information relayed by Blue Rose to tilt, pan and zoom to the precise location for further visual identification of the intruder. This technology is being made available as a commercial product for perimeter security at airports, power plants, oil and gas refineries, commercial and domestic buildings, pipelines and international borders.

**Team members:** Dr. Fletcher Blackmon, Roger Howlett, Gerard Poirier, James Pollock, Naval Undersea Warfare Center, Division Newport; Hugh Murphy, Purvis Systems, Inc.

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### **NE Regional Coordinator Baus Honored as Outstanding Tech Transfer Professional**

Dr. Theresa Baus, Northeast Regional Coordinator, was presented with the first Outstanding Technology Transfer Professional Award at the 2007 FLC awards ceremony in Fort Worth, Texas, on May 17. Dr. Baus was recognized for her work as head of the Naval Undersea Warfare Center (NUWC), Division Newport's Technology Partnership Enterprise Office.

Among Dr. Baus' accomplishments was finding partners in the medical community to further develop and push the commercialization of technologies. From this effort, a groundbreaking technology to improve cancer detection through improved medical imaging was successfully transferred and commercialized.

The Digital Image Enhancement (DIE) system uses wavelets and mathematical functions to help physicians detect tissue anomalies and interpret digital mammograms. Originally used to help sailors identify mines in a cluttered underwater environment, DIE helps physicians look for microcalcifications in a mammogram of dense breast tissue. DIE software is slated to be integrated into commercial use by this summer pending a sublicense agreement with a leading manufacturer of digital mammography equipment. With DIE in place at hospitals and clinics across the nation, doctors will be able to refine and enhance regions of interest or concern within mammography images to improve the detection of cancer in its early stages.

Under Dr. Baus' leadership, NUWC has partnered in a number of Cooperative Research and Development Agreements (CRADAs) totaling over \$9 million, nine patent license agreements with royalties totaling nearly \$2 million, and 81 Work for Private Parties agreements totaling over \$8.6 million.

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### FAA-Sandia Team Receives New FLC Award

A joint effort by a laboratory affiliated with the Federal Aviation Administration (FAA) and Sandia National Laboratories to improve aircraft safety was recently honored with the FLC Interagency Partnership Award. The award, which was presented for the first time at the 2007 FLC awards ceremony in Fort Worth, Texas, on May 17, recognizes the efforts of at least two different agencies for their successful collaboration transferring a technology.

The team worked together to develop the Pulse Arrested Spark Discharge (PASD), a wiring diagnostic tool that can detect and locate a broad range of aircraft defects, such as breached insulation, chaffing, and physically small insulation cracks. Within an aircraft fuselage can be miles of aging wiring, intertwined within complex wire bundles, located behind the side panels. Failure of these wires can potentially cause serious safety hazards. The PASD finds the wiring faults, allowing mechanics to take corrective action before the fault develops into a serious safety hazard. Due to the simplicity of the PASD concept, the technology is readily implemented into a portable diagnostic system and can be applied to a number of aviation and non-aviation wiring systems.

After concluding successful prototype testing, the FAA-affiliated laboratory, located at Atlantic City International Airport, N.J., and Sandia, based in Albuquerque, N.M., transferred the PASD technology to the private sector. It is now available as the ArcSafe® - AS1216 Arc Fault Detection System, developed and manufactured by Astronics Corporation, a Redmond, Washington-based company.

**Team members:** Cesar Gomez and Michael Walz, FAA; Michael Dinallo, Steve Glover, R. Kevin Howard, and Larry Schneider, Sandia National Laboratories.

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### **New Method for Making Improved Radiation Detectors**

Scientists at Brookhaven National Laboratory, with funding from the National Nuclear Security Administration, have devised ways to improve the performance of radiation detectors, such as those used by law enforcement agencies to locate and identify radioactive material.

The improved sensors, for which the laboratory has filed a U.S. provisional patent application, can be used at room temperature, which makes them more practical and cost-effective than existing detectors with similar performance, which must be operated at very cold temperatures using expensive liquid nitrogen. They can also more accurately detect the X-rays and gamma rays emitted by radiological sources such as dirty bombs and other illicit materials. "Improving the performance of radiation detectors could improve the efficiency and accuracy of cargo screening at U.S. ports," said Brookhaven physicist Aleksey Bolotnikov, one of the inventors.

Radiation detectors work by detecting electrons and "holes"—vacancies left by liberated electrons—when ionizing radiation or high-energy particles strike the detector crystal. When the free electrons and holes flow toward electrodes (an anode and a cathode) at either end of the detector, they generate a signal that can be measured and recorded. In an ideal detector, all of the electrons and holes created by the ionization process would arrive at the electrodes. But, in reality, holes travel a very short distance before getting trapped by defects in the crystal. Also, because the electrostatic field inside the detector causes some of the electrons to drift, not all of them arrive at the anode. These losses lead to a subsequent inaccuracy in radiation measurements.

The Brookhaven-designed sensors improve on this situation by combining methods to shield the detector and focus the electrons toward the anode. In addition, the electrodes at each end of the detector give information about how many electrons/holes get trapped. This "correction factor" can then be used to reconstruct the number of electrons/holes originally created by incident gamma rays or high-energy particles. "Together, these techniques enhance the energy resolution and efficiency of these detectors. In practical terms it means that the improved devices will be able to detect more minute quantities of radiation, detect radioactive materials more quickly or from greater distances, better identify the source of the radiation, and distinguish illicit sources of concern from common naturally occurring radioactive materials," Bolotnikov said.

The patent application covers the improved high-energy detectors, as well as methods for making and using them. Details of the electrode design and processing methods are also included.

This technology is now available for licensing. For licensing information, please contact Kimberley Elcess, Principal Licensing Specialist, Brookhaven National Laboratory, (631) 344-4151, [elcess@bnl.gov](mailto:elcess@bnl.gov).

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### Princeton Plasma Physics Laboratory Assists with the Development of Artificial Muscle

Princeton Plasma Physics Laboratory (PPPL) collaborator Lenore Rasmussen has the gift of serendipity. Two disparate life experiences sparked the polymer chemist's interest in the development of electro-responsive "smart materials"—electrically-driven polymers that are strong and durable enough to act as artificial muscles in prosthetic devices and robotics. Her early experience identifying DNA proteins and an injury suffered by her cousin in a farm accident triggered her interest in developing the materials.

Rasmussen was using electrophoresis—the movement of suspended particles through a gel under the action of a strong electric field—to separate and identify protein molecules and DNA. "There are little wells in which you put your proteins or DNA samples. You turn on the electricity and watch how they migrate. Different proteins or DNA fragments will go through the gel at different speeds that depend on their molecular weights. The larger, heavier molecules will have a harder time getting through. One of the wells would contain known proteins for comparison. For DNA, the smaller fragments would move further and longer ones would end up closer to the starting point," explained Rasmussen. But, as fate would have it, one day she made a mistake formulating the gel. "I goofed up mixing stuff together, and (as a result) the gel responded to the electricity by contracting—a Eureka moment," she said.

Later, while she was a graduate student at Purdue University pursuing a degree in biophysics, one of her cousins was spreading hay on a land reclamation project. He slipped and his leg got caught in the hay spreader. His foot was not detached, but much of the muscle and circulation in the calf of his leg were damaged. Initially, doctors were not sure he would keep the leg. If gangrene set in, it would have to be amputated. "I was the scientist and biologist in the family, so they asked if I could go and look at prosthetics to see what was out there in case he needed one," said Rasmussen. "While I really liked what I saw for legs, I really hated what I saw for arms and hands.

"As it turns out, my cousin's leg healed. He had a lot of recovery and still has a slight limp. But I kept thinking about my experience with the gels in DNA analysis and the need for better prosthetics. So I went on to Virginia Tech partly to get the background in polymer chemistry that I would need to develop artificial muscles," Rasmussen stated.

Currently, prosthetics for the arm and hand are not functional unless they utilize three-pronged metal devices that are controlled mechanically. Rasmussen wondered if a prosthetic limb could respond directly to a neural impulse, and whether they could be made more attractive and highly functional. In 2003 she established Ras Labs, LLC, a small, for-profit, innovative research and development laboratory devoted to projects that utilize polymer chemistry, biochemistry, biology and engineering.

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### Princeton Plasma Physics (cont.)

Rasmussen envisions artificial muscles, or actuators, comprised of an electro-responsive polymer gel (known as the smart material) containing embedded electrodes, all encased in a flexible coating that acts as a kind of skin. The smart material is cross-linked, meaning that a side bond has been formed between polymer chains to increase strength and toughness. The embedded electrodes serve a dual role: providing the electric stimulus, much like a nerve; and attaching the smart material to a lever, like a tendon attaches muscle tissue to bone. The thin elastomeric coating also serves as a moisture barrier, preventing evaporation and leakage of the electrolyte solution in the polymer, and allowing the actuators to be fully operational anywhere.

When the electrodes are energized with direct current, the smart material contracts or expands, depending on the formulation. It then relaxes when the current is turned off, acting much like real muscle tissue responding to a neural impulse from the brain. The goal is for both the electro-responsive smart material and the embedded electrodes to move as a unit, analogous to muscles and nerves moving together.

Rasmussen tested a variety of polymers and found that poly hydroxyethylmethacrylic acid and poly methacrylic acid served as a cross-link to network gels, which respond quickly to electricity and have all the other needed properties. But one challenge remained: after repeated cycles, the polymer often detached from the electrodes. However, from her former affiliation with Virginia Tech and with Johnson & Johnson's (J&J) Ethicon division, Rasmussen recalled that J&J performed plasma sterilization of its medical needles and then coated them with polymers that allow them to slide more quickly into patients, reducing discomfort.

A potential solution was at hand. Rasmussen contacted Lew Meixler, PPPL's Head of Applications Research and Technology Transfer. Their discussions resulted in the establishment of a Cooperative Research and Development Agreement (CRADA) last December between PPPL and Ras Labs. The CRADA revolves around PPPL's plasma sterilization equipment, an excellent apparatus in which to treat metal samples with plasma. Different ions are being studied to find a suitable metal and plasma combination that solves the detachment problem.

To date, tests conducted at PPPL are encouraging, resulting in improved bond strengths. Stainless steel and titanium metals are being treated with plasma comprised of ions of nitrogen, helium, or hydrogen. Titanium, in particular, is suitable for use within the body. Oxygen ions derived from synthetic air (for safety) are also used. Ions are driven onto the surface of a 0.5-inch by 1.5-inch metal foil by a 40-volt electric potential for 12 hours.

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### Princeton Plasma Physics (cont.)

Following treatment, a polymer coating is sandwiched between two pieces of treated foil. The composite is then sent to the University of Pennsylvania or to the Princeton Textile Research Institute, which performs adhesion tests on the small samples that fit into PPPL's apparatus. A standardized testing apparatus controls the speed and strain with which the composite is peeled apart. Future tests will be conducted with actual wire electrodes treated in the PPPL apparatus.

In addition to identifying a suitable plasma treatment for metals, the tests at PPPL should provide insight into the mechanism responsible for improved adhesion of the polymer. Preliminary studies have shown that the plasma ions rough up the metal surface on a molecular scale and make the surface super clean by removing any oils that might be present. "Right after the peel test we check to see where the break has occurred. If necessary, we use electron microscopy to view the surfaces," Rasmussen said. "If the polymer comes off the metal cleanly, the interface is the problem. If there are patches of the polymer remaining on the metal, then the failure was in the polymer itself—or there could be other things going on."

Whatever is learned from the PPPL plasma treatments, Rasmussen will continue her quest for electro-responsive smart materials that can have a profound impact on prosthetics and robotics, with excellent control, dexterity, and durability. If she is successful many people may benefit.

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### **Display Emphasizes Importance of Soldier Systems Center**

The U.S. Army Soldier Systems Center (SSC) of Natick, Massachusetts, and the Program Executive Office (PEO) of Fort Belvoir, Virginia, recently showcased current and upcoming equipment for soldiers at the Massachusetts State House in Boston.

State Representative Karen Spilka, who co-hosted the May event, said this was an opportunity to show not only how critical the work accomplished at the SSC is for Natick, but for the entire country. Brig. Gen. R. Mark Brown, commanding general of the SSC and PEO, and another host of the event, said that the support of New England is important to the work that is being performed. Some of the benefits of being located in this area include the intellectual capital, the institutes of higher learning, and the teaching hospitals. "The result is the most capable soldier in the world today," he said. "SSC is one of the only places in the Army where the technology touches the life of every soldier everywhere, every day."

Some of the items displayed included Future Force Warrior, Navy uniforms, unmanned aerial vehicles, microclimate cooling, an advanced combat helmet, enhanced night vision goggles, and field feeding items, which the display-goers could taste.

James Leary, chief of staff and general counsel for the lieutenant governor, said that it has been great to have had the SSC in Massachusetts for the past 53 years, and the state is looking forward to the next 50 or 100 years. "What you do is critical to the country," he said. "It is hard to imagine this center anywhere else."

Massachusetts Undersecretary for Business Development Bob Coughlin said that the state wants to maintain its partnership with SSC in order for the good work that is done in Natick to continue. "It's the natural place for what you do," he remarked. He closed by saying, "God bless our troops. They are the most important thing." Other state representatives who sponsored this event were Senator Scott Brown and Representatives David Linsky and Alice Peisch.

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### "Combination" Lyme Disease Vaccine Proteins Patented

Scientists at Brookhaven National Laboratory and collaborators at Stony Brook University have received a U.S. Patent (No. 7,179,448) for developing chimeric, or "combination," proteins that may advance the development of vaccines and diagnostic tests for Lyme disease.

The genetically engineered proteins combine pieces of two proteins that are normally present on the surface of the bacterium that causes Lyme disease, but at different parts of the organism's life cycle. "Combining pieces of these two proteins into one chimeric protein should trigger a 'one-two-punch' immune response more capable of fending off the bacterium than either protein alone," said Brookhaven biologist and researcher John Dunn. "These chimeric proteins could also be used as diagnostic reagents that distinguish disease-causing strains of bacteria from relatively harmless ones, and help assess the severity of an infection."

Lyme disease is the most common vector-borne disease in the U.S., causing approximately 25,000 new cases each year—a rate that is expected to increase by at least one-third from 2002 to 2012, according to a new study. Early symptoms of the disease, which is spread by the bite of an infected deer tick, include a bull's-eye rash at the site of the bite and flu-like symptoms. If not promptly treated with antibiotics, it can lead to more serious symptoms, including joint and neurological complications.

Scientists have been working on vaccines based on the structures of proteins found on the outer surface of *Borrelia burgdorferi*, the bacterium that causes Lyme disease. Dunn and colleagues deciphered the atomic-level structures of these proteins, known as outer surface proteins A and C (OspA and OspC), at the National Synchrotron Light Source (NSLS) at Brookhaven Lab. The OspA protein, which was used to make the original vaccine against Lyme disease, is only present in the bacteria while they are in the cold-blooded deer tick's stomach, and not in the host. After the tick bites a warm-blooded mammalian host, the injected bacteria produce OspC on their surface.

With the aim of developing a vaccine that would trigger an immune response against both of these life-cycle stages, Dunn's team used methods of recombinant DNA to create new proteins that combine the most immunogenic portions of OspA and OspC—that is, the regions of the two proteins that are most likely to trigger an immune response.

The researchers have demonstrated that the new combination proteins retain the ability to trigger an immune response to at least one or both of the antigens, and can trigger the production of antibodies that inhibit the growth of and/or kill *Borrelia* bacteria in laboratory cultures. They have also shown that the chimeric proteins can be mass-produced in *E. coli* bacteria, a common laboratory technique for making proteins, and easily purified for possible use in vaccines or diagnostic assays.

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### "Combination" Lyme Disease Vaccine (cont.)

"This could lead to a vaccine that is effective at different stages of the organism's life cycle," said Dunn. Moreover, by incorporating unique protein fragments from various pathogenic families of *Borrelia*, these chimeric proteins could be used to distinguish clinically important exposure to disease-causing *Borrelia* from exposures to other nonpathogenic families of *Borrelia*.

The patent covers the development of the chimeric proteins themselves, the nucleic acids (genetic material) used to generate the proteins, the methods used to make the proteins, the methods used to deliver either the proteins or nucleic acids, the use of the proteins in diagnostic assays or kits, and their use in animals and humans as vaccines against Lyme disease.

This research was funded by the Office of Biological and Environmental Research within the Department of Energy's Office of Science and by the National Institutes of Health.

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### **2007 NE Region Fall Meeting – Save the Date!**

The fall 2007 Northeast Region meeting will take place September 24-26 in Natick, Massachusetts.

Check for updates on the Northeast Region website at [www.flcnortheast.org](http://www.flcnortheast.org).