Grants for prototype development are funded by a joint effort of the URI Foundation and the Vice Provost's Office to support projects that could lead to significant patent possibilities. The URI Foundation thanks Vice Provost Thomas J. Rockett and his office for their generous support.

Partners in Funding

Profiles by Arliss Ryan

Read About the Following Prototypes

- New e-coat (electrophoretic coating) formulation for automobile, aircraft, coil, and metal coating.
- Modifications to a device that combats deer ticks to also control the lone star tick.
- Development of a new technology called DCD (Disk Caching Disk), which makes disk write access time an amazing 200 times faster.
- Live oral vaccine to protect humans from E. coli.
- Magnetic separation device for chemical and biotechnological applications.

E-gad! What's an E-coat?

You'll never wear an e-coat, but your car is wearing one right now. E-coat stands for electrophoretic coating, and it's a process every automobile frame goes through during assembly. An e-coat bath is a huge tank containing about 90,000 gallons of epoxy resin dispersed in water. Each auto body is immersed in the bath, and a voltage of 200V is applied to the body to cathodically deposit the resin onto the metal surface. This epoxy coating serves as an undercoat, beneath the decorative acrylic paint, to prevent corrosion. A grant of $6,500 will enable Professors Sze C. Yang, Department of Chemistry, and Richard Brown, Department of Chemical Engineering, to continue the development and testing of a new e-coat formulation that promises to have widespread applications in a number of major industries.

"In the next stage of patent development, we plan to demonstrate the new URI e-coat to potential industrial partners," says Yang. "To do this, we need to prepare coating on larger metal pieces than our current laboratory allows. The grant will enable us to expand our laboratory capacity so that we can provide large samples for competitive testings in the coating industry."

Professors Sze C. Yang, Department of Chemistry, and Richard Brown, Department of Chemical Engineering

The URI e-coat solves a variety of current problems in the coating industry. For example, in the case of automobile coating, a $3.1 billion annual market, the existing e-coat process protects steel but not aluminum, to which auto manufacturers are increasingly turning for lightweight parts. The only alternative, chromate-based coating, is not viable because of environmental concerns about the toxicity of the chromate. The URI e-coat protects both steel and aluminum in a single application, reducing assembly costs and eliminating the need for chromate altogether. In the aircraft coating industry, where aluminum alloys require corrosion protection, the new URI e-coat is poised to take the entire $500 million annual market from the chromate-based paint industry.

Other potential markets ripe for the entry of the URI e-coat include coil coating (a prime example of coil coating is aluminum soda cans) and coatings on metal parts for appliances, boats, and bridge and building structures. The formulation can be easily integrated into existing production processes, making its low start-up cost particularly attractive. So think about that e-coat the next time you get in your car. In years to come, that e-coat may be the very one developed at URI.

Ticks Pay Deerly for Going A-Head

"I'm having a major problem on my farm with the lone star ticks," writes a Prudence Island farmer in a letter to Dr. Elyes Zhioua. "I have 12 horses, 10 head of cattle and 8 pigs. These animals get infested with ticks from April through November … We spend hundreds of dollars every year on veterinarian bills, antibiotic and repellent sprays and it is getting worse every year … These ticks are also a problem with my family … I have taken 72 ticks off one of my sons this year, 48 off the other, 18 off my husband, and 21 off myself."

Most of us are familiar with the Lyme disease-carrying deer tick. The lone star tick is the third major livestock pest in the United States with an annual loss estimated at $389.9 million. The lone star tick is also a carrier of a potentially fatal illness to humans called ehrlichiosis. Like the deer tick, the lone star tick congregates on the heads of white-tailed deer. Fortunately, a device already developed by entomologists (Professor Roger LeBrun and Research Assistant Professor Zhioua of URI's Plant Science Department) and engineers (David Butler and Gordon Salisbury of Applied Imagination) to combat deer ticks can now be modified to control the lone star tick as well. A grant of $19,860 will help fund this effort.

This device is a shower-like gadget, consisting of a box mounted on a six-foot pole. When deer are lured to the device by a closed basket of food, a heat sensor confirms the creature is a deer, and a spritz of microscopic fungus is sprayed onto the animal's head. The deer strolls away, unharmed; the ticks, thanks to the fatal fungus, will soon be dead. The same fungus also kills lone star ticks. However, because lone star ticks are most active in summer when the outdoor temperature is almost equal to the body temperature of the deer, the heat sensor is less effective in triggering the fungal spray. A new detection system is required. The housing and mechanisms will also require some modification.

Farmers, cattle ranchers, and any landowner plagued by ticks will find this device is not only their best ally in the war on ticks but also extremely convenient to use. It's battery-powered, self-contained, weighs a mere twenty pounds, and can be set up without tools. It operates automatically, unattended, for long periods of time, and its easy-to-assemble design even allows it to be shipped by regular mail. With prototype development underway, the next step is field trials in the summer of 1999. A certain letter-writing farmer on Prudence Island has offered her property for the field study. She's hoping her family and her animals can soon say goodbye to ticks.

Professor Roger LeBrun and Dr. Elyes Zhioua, Plant Science Department

Improving Your Cache Flow

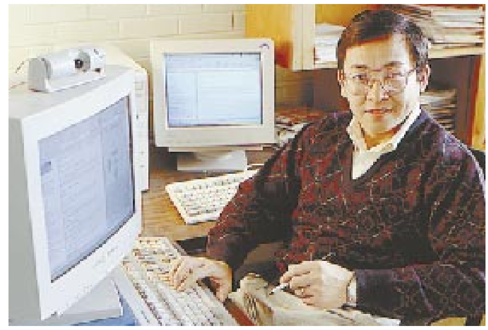
Almost everyone has had the experience of sitting at a computer, waiting, while the flashing light indicates the disk (hard drive) is working to read or write data. If we're of a nontechnical bent, we think "Pretty nifty!" and patiently sit back while the computer does its mysterious work. But in the computer industry, that flashing light means there's room for improvement. With the help of a $9,768 grant, Professor Qing Yang of the Department of Electrical and Computer Engineering will continue the development of a new technology called DCD (Disk Caching Disk) which makes disk write access time an amazing 200 times faster.

The DCD concept is fairly simple. Every disk consists of a platter with many tracks which store information and a magnetic disk head which rests atop the platter. When you turn on your computer, the disk automatically begins to rotate. To read or write information, the disk head must move from its present location to the track where the desired information is stored. This is called seek time. Each track has many sectors, but you can read or write only one sector at a time. So now you must wait for the disk to rotate until the sector you want to access is under the disk head. What DCD does is to combine the hundreds of seek and rotate operations into a single seek and rotate. Now that's fast!

DCD will also bring the disk up to speed with the two other main computer components involved in processing data, the CPU (Central Processing Unit—the chip) and the RAM (Random Access Memory). Since the early 1970s, CPU speed has increased from handling 6,000 instructions per second to 450 million instructions per second. RAM speed has also improved, providing access time in tenths of a nanosecond. But until DCD, disk speed was still plodding along virtually unchanged for two decades. DCD will change all that.

"We expect DCD to have a major impact on the computer industry," says Yang. "We already have a patent on the technology and have done real-world tests using Hewlett-Packard traces which confirm the DCD improves write performance up to 200 times compared to existing disk architecture."

Yang has also received a $359,000 grant from the National Science Foundation in recognition of the significance of his work. The URI Foundation grant will be targeted toward developing a prototype for implementing DCD technology on Windows NT. Such a prototype will attract industry people to license the patent, which is held by the Intellectual Property Committee of URI. The benefits to the University will be pretty nifty, indeed!



Professor Qing Yang, Department of Electrical and Computer Engineering

A Vaccine For E. Coli?

Most of us have heard of E. coli, the bacterium associated with outbreaks of fatal illness when people eat undercooked, infected beef from fast-food restaurants. In fact, although there are over 120 E. coli strains, the specific culprit in this case is E. Coli 0157:H7, a pathogen which causes some 20,000 infections and 250 deaths annually. Now, a $4,000 grant will assist Professor Paul S. Cohen of the Department of Biochemistry, Microbiology, and Molecular Genetics to expand on previous research that may lead to a live oral vaccine to protect humans from E. coli.

Cohen's work originally focused on Salmonella, another deadly bacteria associated primarily with contaminated eggs and poultry. That research led to the development of a new live oral Salmonella vaccine for poultry, with a patent pending. In the process, it was seen that the same defective gene that is key to the Salmonella vaccine is present in E. coli. Can the gene now be manipulated in a new way to combat E. coli?

"What we are doing now is a logical extension of our previous work," says Cohen. "Our plan is to inactivate the gene in E. coli 0157:H7 and test it on laboratory mice. If it becomes avirulent [which means it won't harm the mice], will it then produce antibodies in the mice which will protect them against exposure to the virulent E. coli strain? If it does, then it is possibly a good vaccine."

Cohen will be aided in this research by URI Ph.D. candidate Kathleen Wosencroft and technician Mary Leatham, M.S. If their work does eventually result in a viable vaccine, both the pharmaceutical industry and the government are sure to be interested. Moreover, since the defective gene may be shared by still other bacterial pathogens, the work could lead to more vaccines with widespread applications. Cohen and the URI lab could be busy for years to come.

Technician Mary Leatham, Ph.D. candidate Kathleen Wosencroft, and Professor Paul S. Cohen, Department of Biochemistry, Microbiology, and Molecular Genetics.

Target Practice

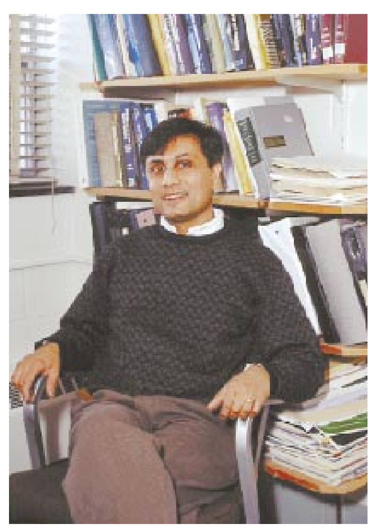
Remember playing with magnets when you were a kid? Professor Arijit Bose, Department of Chemical Engineering, has been playing with magnets in an exciting new way. He has developed a prototype for a magnetic separation device that would be the first of its kind. A $12,000 grant will fund the testing necessary to bring the device to full operation.

What exactly is magnetic separation? Let's say your water supply is contaminated with PCBs. To remove the PCBs (called "target material"), tiny magnetic particles coated with a chemical that absorbs PCBs are added to the water, then separated out with the PCBs attached. By suspending many particles as small as 2–3 microns in diameter in the solution, a large amount of surface area is made available for attachment of PCBs. Depending on the coating, the magnetic particles can be used to separate out a variety of target materials, including nuclear waste. At present, the process is done only in small batches, a costly and time-consuming operation.

Bose's device allows for a high-volume, continuous process. First, the solution enters a rotating, horizontal glass tube, approximately one-meter long by three centimeters in diameter. Solenoids around the tube produce a current that keeps the mixture in suspension while the magnetic particles attract the target material. Next, a series of oscillating magnets outside the tube pushes the particles into the center of the tube so they flow out a central port while the excess solution is diverted to a different exit. The key here is that the magnets push the particles to the center rather than pulling them to the sides of the tube. In the second step, the link between the magnetic particles and the captured target material is broken, and the particles are again pushed to the center so they can exit separately and be recycled and reused.

"So far, we have developed a semi-continuous prototype," says Bose. "The grant will enable us to test the concept that we can use magnets in a particular way to push particles away from the magnets and not toward them. Our calculations tell us it will work. Now it is critical that we demonstrate it."

If the testing is successful, the apparatus would eventually be marketed for large-volume chemical and biotechnological applications. It's amazing what can happen when you look at something as simple as a magnet in a brand new way.



Professor Arijit Bose, Department of Chemical Engineering