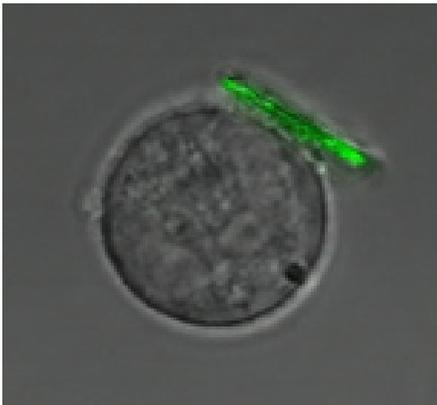


NSF AT WORK



Researchers Build Drug-Delivering Backpacks for Cells

Massachusetts Institute of Technology (MIT) engineers have outfitted cells with tiny "backpacks" that could allow them to deliver chemotherapy agents, diagnose tumors or become building blocks for tissue engineering.

Michael Rubner, director of the NSF-supported Center for Materials Science and Engineering at MIT and senior author of a paper on the work, said he believes this is the first time anyone has attached a synthetic patch to a cell.

MIT researchers have developed a technique to attach tiny polymer "backpacks" to cells. The immune system cell pictured here--a B lymphocyte--sports one. Credit: Reprinted with permission from "Surface Functionalization of Living Cells with Multilayer Patches," *Nano Letters* (Nov 1, 2008). Copyright © 2008, American Chemical Society.

The polymer backpacks allow researchers to use cells to ferry tiny cargoes and manipulate their movements using magnetic fields. The researchers worked with B and T cells, two types of immune cells that can hone in on various tissues in the body, including tumors, infection sites and lymphoid tissues--a trait that could be exploited to achieve targeted drug or vaccine delivery.

Cellular backpacks carrying chemotherapy agents could target tumor cells, while cells equipped with patches carrying imaging agents could help identify tumors by binding to protein markers

expressed by cancer cells. Read MIT's press release, "[Tiny Backpacks for Cells](#)" for more on how these backpacks are made.

Innovative Nanofibers Clean Up Small Engine Exhaust

Catalytic filters made of ceramic nanofibers will soon be cleaning up the exhaust emissions of outdoor equipment such as lawn mowers and gasoline-powered leaf blowers. The small size and light weight of the filters, along with a lower cost, make them feasible for use with many small gasoline engines.



MemPro is working quickly to commercialize its line of catalytic filters well before new Environmental Protection Agency emissions standards for small spark-ignition engines take effect in 2011 and 2012. Credit: MemPro Ceramics Corp.

In tests, ceramic nanofibers have efficiently and reliably reduced emissions of nitrogen oxides, carbon monoxide, particulate matter and hydrocarbons--pollutants that lead to ozone, smog and adverse health effects. The pollution-controlling nanofibers were discovered by researchers at the [University of Akron](#), which licensed the technology to a growing company specializing in ceramics, [MemPro Ceramics Corp.](#) With the support of two NSF [Small Business Technology Transfer](#) grants, MemPro has been testing the characteristics and performance of their ceramic nanofiber [NOXFOX™](#) catalytic filters.

Fungus for Fuel

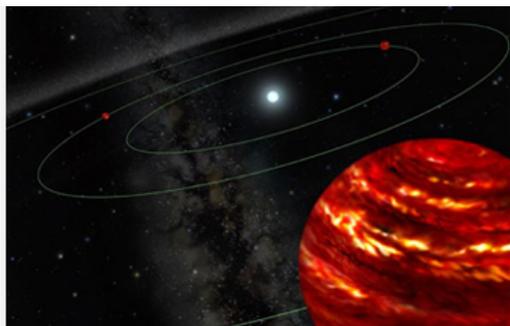
Gary Strobel, of Montana State University, found a fungus in the Patagonian rainforest that could one day be used to replace petroleum-based diesel fuel. The fungus, *Gliocladium roseum*, produces many of the same energy-rich hydrocarbons as diesel.

Strobel is no stranger to big discoveries; in 1993, he discovered the fungus that contained Taxol, an anticancer drug. During his latest eureka moment, Strobel found *G. roseum* in an ancient family of trees known as ulmo. Most biofuel crops require several modifications before being turned into fuel, but *G. roseum* could potentially produce fuel without these processes. This promising research demonstrates how a fungus might generate "myco-diesel" without modification, resulting in the ability to diversify energy resources and reduce dependence on fossil fuels.

Strobel's NSF-funded research was recently featured on [NPR](#). During this segment, Strobel discussed the importance of alternative fuel and the possible applications of his new discovery. To learn more about Strobel's research, see the NSF press release, [Obscure Fungus Produces Diesel Fuel Components](#).



Cultures of the fungus *Gliocladium roseum* produce hydrocarbons. Credit: Gary Strobel



Artist's conception of the multiple planet system, initially discovered with Gemini North adaptive optics images. Credit: Gemini Observatory artwork by Lynette Cook

New Planets Discovered in Distant Solar System

Astronomers using the Gemini North telescope and W.M. Keck Observatory on Hawaii's Mauna Kea, the tallest mountain in the Hawaiian chain, have obtained the first-ever direct images identifying a multi-planet system around a normal star.

The team, led by Christian Marois of the National Research Council at Canada's Herzberg Institute of Astrophysics, used the telescopes' adaptive optics technology to correct for atmospheric turbulence, the shimmering or blinking of starlight as it passes through the earth's atmosphere.

"This discovery is significant--it is the first time a family of planets around a normal star outside of our solar system was imaged," said Brian Patten, program manager at NSF.

"Scientists may now directly view planets themselves, as opposed to indirectly through a star's spectrum or its brightness."

For more information, see the NSF press release on the [Planetary "First Family"](#) or read the Nov. 13, 2008, issue of [Science Express](#), an international weekly science journal.

DID YOU KNOW?

A total of 180 U.S. and U.S.-based researchers have had their research pursuits funded by NSF at some point in their careers--and sometimes throughout their careers. By the time they are recognized internationally, their early fundamental research has developed implications

for such broad areas as the environment, business and decision-making. In 2008, the past and present NSF-funded researchers are Paul Krugman, who earned the prize for economics; Yoichiro Nambu, who earned the prize for physics; and Osamu Shimomura, Martin Chalfie and Roger Y. Tsien, who share the prize for chemistry. For more information, see the [NSF press release](#), or visit the NSF Special Report on the [NSF-Nobel Prize Connection](#).



Credit: National Science Foundation

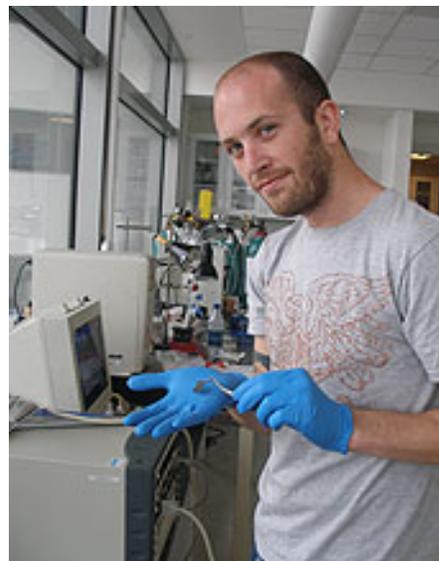
FACES OF NSF RESEARCH

Supercapacitors: Keys to the Future

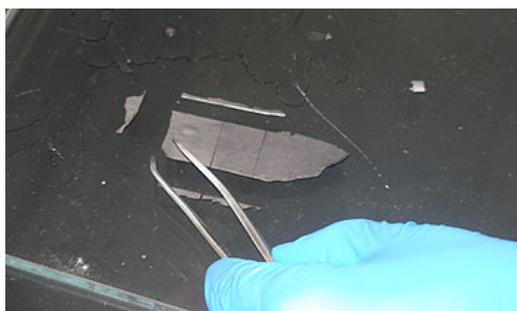
As scientists look to tomorrow to find the problems that need to be addressed today, one clearly stands at the top of the list: energy. Supercapacitor research by John Chmiola, a doctoral student at Drexel University, might be the key to a new wave of energy storage devices with increased efficiency.

Chmiola's research, funded through NSF's Integrative Graduate Education and Research Traineeship ([IGERT](#)) program, has been able to show how supercapacitors are supporting power delivery applications. Supercapacitors--most commonly used in backup power applications because of their infinite lifespan--are electronic devices that have an unusually high energy density when compared to common capacitors.

Traditional power sources and batteries, essential to our personal electronic devices and automobiles, don't store that much energy. Due to their high storage energy capacity, supercapacitors are finding increased usage in portable electronic devices like MP3 players, mobile phones and other hand-held devices. Other benefits, like short charging times and high performance in low temperatures, could lead to new applications.



John Chmiola holds an electrochemical capacitor's electrode produced from titanium carbide-derived carbon. Credit: John Chmiola, Drexel University



Electrochemical capacitor electrodes from titanium carbide-derived carbon (TiC-CDC). Credit: John Chmiola, Drexel University

Chmiola's research exploits supercapacitor conducting abilities by minimizing nanopore size within the capacitor's carbon-exchange framework. By precisely matching the nanopore size to the ions passing through the conductor, Chmiola has increased the amount of electrical charges it can hold by about 50 percent.

This astounding result has direct and potentially far-reaching implications as it could help manufacturers create smaller and cheaper power packs for everything from cameras to cars. Read more about this new-age storage capability in [NSF's Discovery](#).

NSF IN THE NEWS

['Bionic' pair seeks Webcams for eyes](#) (*ABC*, 11/20/08) Engineers and medical professionals use modern technology to aid two people who seek "bionic" replacements for injured eyes. NSF-sponsored researchers are creating realistic-looking prosthetic eyes with one small modification: mini-webcams embedded in the pupil. What a way to see the world!

[Women lead in bacteria, hands down](#) (*The Associated Press*, 11/03/08) A new study found that women have a greater variety of bacteria on their hands than men do. NSF-supported researchers sampled the palms of 102 hands and tested the samples using a new, highly detailed system for detecting bacteria DNA. They identified 4,742 species of bacteria overall. The average hand harbored 150 species of bacteria.

[NASA joins NSF research portal: NSF Web site aims to consolidate information on federally funded research](#) (*Government Computer News*, 10/31/08) NASA has become the second agency to begin offering information about its federally funded research projects on the research.gov Web site launched last year by NSF. NSF intends for the site to become a government-wide portal to make grant information more easily accessible to the public as well as the research community, said NSF spokeswoman Maria C. Zacharias.

THE RIPPLE EFFECT

New Business R&D and Innovation Survey to Be Introduced

A new NSF [Survey of Business R&D and Innovation](#) will be mailed to 40,000 U.S. firms in January, 2009. This redesign of the NSF annual Survey of Industrial R&D, which has been conducted for over 50 years, responds to a 2003 commissioned report supported by the National Research Council, "[Measuring R&D Expenditures in the U.S. Economy](#)." The report emphasizes that understanding the major changes taking place in business R&D and innovation is critical to the future of the U.S. economy and national well-being.

Additional recommendations from the report include learning more about R&D record keeping in industry, collecting reliable data on industry R&D by line of business, building the capacity to collect innovation-related data for integration with the R&D Survey and creating a panel of R&D experts to provide guidance on trends and issues.

Following the report, NSF initiated an R&D record keeping study in 2005 and created an industry expert panel to describe the future drivers of R&D investment and innovation in 2006. During 2007 NSF redesigned and expanded the survey based on these inputs and many others. The name was also changed to Business Research and Development Survey. A new Business R&D Expert Panel was convened by NSF in 2008 to review changes in the survey and to offer advice on how to introduce it to the recipients for maximum response.

A recent letter from Norman Augustine, former CEO of Lockheed Martin, to several thousand CEOs requests support in advocating full and accurate responses by their firms. Special emphasis is placed on the mandatory and confidential nature of these responses and the ability to respond electronically. This action will enable better measures of business R&D efforts in keeping America competitive and assist our nation's leaders in making sound policy decisions. Letters also went to past survey respondents to determine whether or not they are still the best person to serve as coordinator to gather all information requested in the new survey.

The new survey will request a wide array of data covering R&D and innovation activities of firms operating in the United States. New or expanded areas of the survey are listed below:

- R&D Financial Measures
- R&D Management and Strategy
- R&D Funded or Paid for by Others
- R&D Human Resources
- Intellectual Property, Technology Transfer and Innovation
- Participation in Specific Technology Transfer Activities

For further information, contact Raymond M. Wolfe, Research and Development Statistics Program, Division of Science Resources Statistics, National Science Foundation, 4201 Wilson Boulevard, Suite 965, Arlington, VA 22230; rwolfe@nsf.gov.



FYI: Response to the survey is mandatory for reporting officials, according to Section 224, Title 13 of United States Code. Credit: Northeastern Illinois University



The National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science with an annual budget of about \$6.06 billion. NSF funding reaches all 50 states through grants to over 1,900 universities and institutions. Each year, NSF receives about 45,000 competitive requests for funding and makes over 11,500 new funding awards. The NSF also awards over \$400 million in professional and service contracts yearly. Contact [NSF's Office of Legislative and Public Affairs](#) for more information, to unsubscribe or for permission to reuse newsletter images.