INDUSTRIAL LIAISON PROGRAM℠
MIT technology insider
FROM THE EDITORS OF TECHNOLOGY REVIEW

CONTENTS | 11.04

KEY

	FUNDING
$	UNDER $2 MILLION
$$	$2 MIL.-$10 MIL.
$$$	$10 MILLION PLUS
	PATENT STRENGTH
🗋	NO CORE PATENTS
🗋🗋	CORE PROTECTION
🗋🗋🗋	DOMINANT POSITION
	TIME TO MARKET
◷	LESS THAN 1 YEAR
◷◷	1-3 YEARS
◷◷◷	MORE THAN 3 YEARS

AN MIT ENTERPRISE TECHNOLOGY REVIEW

SPINOFF SPOTLIGHT

Taming the Torrent of RFID Data

OAT SYSTEMS' SOFTWARE AIMS TO COLLECT, MANAGE, AND TURN A PROFIT FROM THE INFORMATION PRODUCED FROM RADIO FREQUENCY IDENTIFICATION

Radio frequency identification (RFID) tag tech-nology is poised to take off in the consumer world next year, and OAT Systems, a software company started by two MIT graduates, is ready to take advantage of what it believes will be a booming market.

The tiny tags, embedded in products, shipping containers, and merchandise pallets, carry electronic product codes (EPCs) that uniquely identify every item. The EPCs contain much more information than the bar codes currently in use. A bar code tells a scanner that a can of Coke, say, is a can of Coke. An EPC identifies which specific can of Coke it is, what batch it came from, and where it was produced. And because the tags rely on radio wave technology, they can be read even when they're inside a crate or a truck. The hope is that, with the ability to track such information, retailers will have better inventory control and will be more likely not to have overstocked one item while running short of another. Eventually, computers might track every component of a product from manufacturing through shipping, sales, and even recycling.

Reading the tags and collecting their data is only a start. In order to get value from the technology, retailers need software to manage the data. And that is OAT's role. The company's suite of software collects and manages RFID data for use in the automation of other business processes.

Take shipping. Currently, a loading-dock worker filling a purchase order for 15 cases of widgets counts the cases, sees them loaded onto the truck, and enters the data into a computer. A shipper such as Federal Express scans signatures to verify delivery. There's plenty of room for human error, and not everyone uses the scanning systems.

"If you just take RFID data and just shove the information into a system, it's useless," says OAT's chief technology officer, Sanjay Sarma, who is currently on a leave of absence from his position as associate professor of mechanical engineering at MIT. "You've got to have a context."

OAT software provides just such context for RFID data, says CEO Prasad Putta, who, like cofounder Sridhar Ramachandran, earned a master's degree in mechanical engineering at MIT. OAT's program determines whether each packing case contains the right number of widgets, each pallet holds the right number of cases, and each truck is carrying them to the right destination. Should any of the widgets be recalled, the system will know where they went.

OAT Systems

$$$

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Click **here** for a graphical analysis of OAT Systems's patent position.

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"All the context of the business process today is tied up in the head of the user," says Putta. With the new technology, a computer, rather than humans, can verify shipments, send bills, and alert the sales department that orders have been filled. Taking the human out of the system removes a source of error. "RFID is a watchdog. It's able to do this automatic data capture," Putta says. "Now you can make sure that you put the right controls on the business process, so you can make sure what's supposed to be happening is happening."

These days, when people are looking at the supply chain that runs from manufacturer to distributor to retailer, they're essentially looking at forecasts—how much of a product might be needed at a certain place and time. But, Putta says, 8 percent of the time, a customer looking for a hot item finds that it's out of stock. RFID, he adds, promises a system that could cut such disappointments in half, bringing more revenue to the retailer. The system could also improve the automation of manufacturing processes by giving man-

CONTINUED ON PAGE 2

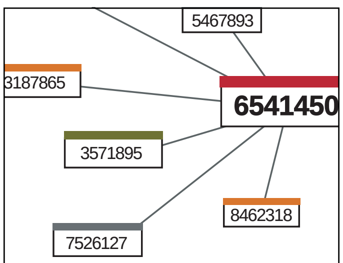
AT A GLANCE

NAME
OAT Systems

PRESIDENT
Prasad Putta

CONTACT
oatsystems.com

PRODUCT
> Software for reading and managing RFID data



PATENT MAP

For a graphical analysis of OAT Systems' patent position, go to www.tecpatents.com/techinsider/November%202004/November_2004.htm.

agers better understanding of and control over the various steps.

Manufacturers of RFID readers make software that collects the data, and large companies such as IBM and SAP are writing programs to import the data into their process-control software. Other small startups are writing so-called middleware to tie parts of systems together. But Putta says OAT is unique in building a comprehensive software package that covers the whole process.

Competition is heating up: In late 2002, Gillette signaled its support for RFID technology when it ordered half a billion tags to track its razors and other products. Starting in January, Wal-Mart will require its 100 largest vendors to install RFID tags in merchandise shipped to its North Texas stores. By June, the giant retailer wants the system in six distribution centers and 250 stores, and by October, in 13 centers and 600 stores. By January 2006, Wal-Mart expects its 300 largest suppliers to be participating.

Sarma is a cofounder—along with David Brock, principal research scientist at MIT's Laboratory for Manufacturing and Productivity—of the Auto-ID Center. The center's goal was to develop RFID and EPC from an interesting idea into an actual industry. (Last October, the Auto-ID Center was disbanded and its work turned over to EPCglobal, on whose board of directors Sarma serves. The nonprofit organization is working to develop worldwide RFID standards.) By late 2000, the center was doing field trials of tracking systems, but it hadn't attracted much interest. Then, Sarma says, "suddenly Gillette made this announcement, Wal-Mart made this announcement, and it was this hot new field."

Sarma had been working with his students to develop Savant, software to handle the data, but students graduate and leave. Regretting the lack of continuity, Sarma eventually turned to OAT, which was named for the Open Air Theater at the Indian Institute of Technology, Madras (where Putta and Ramachandran were undergraduates).

Hoping to kick-start RFID, Sarma developed Savant as freeware. MIT holds no patents on the technology, but OAT has applied for patents on its subsequent developments.

OAT, meanwhile, is working to spread the technology through partnerships with more than three dozen hardware and software makers, including Intel and Hewlett-Packard. Its customers include Eastman Kodak, Target, LG Electronics, and Kimberley-Clark. OAT, an 87-employee company based in Waltham, MA, raised $11.5 million in venture funding in September 2003, but now it supports itself mostly through sales, Putta says.

"OAT's major strength is that it got into the market very early and got some good wins and good contracts," says Sharyn Leaver, a research director at Forrester Research, a market analysis firm. "They are probably the strongest when it comes to successful implementation and customer orders."

But as RFID moves from an early-stage technology to one that's more widely accepted, Leaver says, small firms like OAT will face increasing competition from big-name makers of business software such as IBM. That may require OAT to form partnerships with such companies.

Putta expects there are changes ahead for his company as the technology is adopted, but OAT is ready to face the challenges. "As the market is evolving, we are evolving," he says.

MIT technology insider
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  web.mit.edu/newsoffice/2004/diabetes2.html

- MIT team identifies new bladder cancer risks

  web.mit.edu/newsoffice/2004/bladdercancer.html

- MIT prof wins Nobel Prize in physics

  web.mit.edu/newsoffice/2004/nobel-wilczek.html

MULTIMEDIA LINKS

- Astronaut Alum Attends Reunion via Space Link

  mitworld.mit.edu/video/231/

- Engineering Dean Thomas Magnanti on Engineering Complex Systems

  mitworld.mit.edu/video/233/

Digital Serendipity

Imagine picking up a novel at a bookstore and instantly your cell phone receives a text message containing your friends' opinions of the book, as well as suggestions for films you might enjoy. Media Lab doctoral candidate Hugo Liu is creating Ambient Semantics, a system that will do just that: a sensor embedded in a ring or wristwatch will identify an object with a radio frequency identification tag affixed, search a database for information about the object, and on the basis of the wearer's interests, send pertinent data as well as recommendations to his or her cell phone or PDA.

Ambient Semantics is based on InterestMap, which Liu built by gleaning information from Web pages, online communities, and social networks. The directory, comprising some 50,000 items, can be used to predict personal preferences. For example, if a person likes the music of Led Zeppelin, InterestMap can guess that she might also like the film *School of Rock.*

Liu has built working prototypes of the wearable sensors and is currently developing other applications for the technology.

Decoding the Genome

Although scientists finished sequencing the human genome more than four years ago, little is known about how genes get called into action. Scientists at MIT and the Whitehead Institute for Biomedical Research, however, have taken a step toward understanding this process: they have found all 203 controlling elements in the yeast genome. Controlling elements are specific parts of the genome that turn genes on and off by interacting with molecules called gene regulators. By discovering where regulators bind to the genome, scientists can determine their function. The team, led by Whitehead researchers Richard Young and Ernest Fraenkel, along with MIT computer scientist David Gifford, is particularly interested in these molecules because mutated regulators are associated with many diseases, including diabetes and cancer.

Previously, it could take years to find a regulator's binding site. The MIT and Whitehead researchers developed a method to speed up the process. First, they subjected cells to about a dozen different environments to reveal which genes are turned on to help cells cope with certain conditions. Then they found the regulators' rough location: they placed them on chips containing thousands of pieces of DNA and observed where the regulators bound. Finally, using computer algorithms to compare these data with data from other yeast species, the researchers were able to identify precise binding locations. The researchers are now applying these techniques to the human genome.

At Home in the Lab

This September, MIT and TIAX, an independent research group based in Cambridge, MA, announced the launch of PlaceLab, a residential condominium in Cambridge that has been designed to allow researchers to test new technologies in the context of everyday life. PlaceLab is outfitted with hundreds of sensors—on walls, cabinets, light switches, and furniture, for example—that monitor occupants' behavior. The idea, says Stephen Intille, the director of the PlaceLab project on the MIT side, is that "technologies developed out of context are often hard to use and don't improve the quality of life." And, Intille adds, "once you put a device in the home, the way people use it changes."

Although the collaboration was officially announced this fall, PlaceLab has been up and running since the summer. Two volunteers living in the condo for 10 days each generated some 500 gigabytes of data. In addition to testing new technologies and developing prototypes for encouraging healthy behavior, the researchers aim to create a library of everyday behaviors. For example, they'll be able to determine how long it takes people to do dishes—useful information for home technology designers.

Electronics See the Light

Yoel Fink, the Thomas B. King Assistant Professor of Materials Science, and his colleagues have created flexible fibers that combine the features of fiber optics and semiconductor devices. The result is a material that can both sense light and analyze information about it. Mehmet Bayindir, a postdoc in the Research Laboratory of Electronics and the lead author of a recent paper in *Nature* about the technology, says that the fibers are fine and flexible enough to be woven into fabric. One possible application, he explains, would be a jacket that responds to different kinds of light. The technology could also be used for a new computer interface: instead of manipulating a mouse or touchpad, users could interact with a system by pointing a beam of light at its screen.

The researchers made the light-sensing fibers by creating a cylinder that is 20 centimeters long and 35 millimeters in diameter. Its semiconductor core was surrounded by four metal wires coated with a polymer sheath. The team heated the cylinder in a furnace and slowly drew it into a fiber hundreds of meters long and less than a millimeter thick. The researchers are exploring other applications for the fibers, including building very large, transparent structures that can sense and respond to light.

Shedding Light on Medicine

PETER SO'S LABORATORY IS DEVELOPING OPTICAL-IMAGING TECHNIQUES THAT HELP FIND CANCERS AND ACCELERATE DRUG DISCOVERY

AT A GLANCE

NAME
Peter So's lab

DIRECTOR
Peter So

CONTACT
web.mit.edu/solab

MAJOR PROJECTS
> Endoscope for imaging cancer cells
> System for mapping cells in an organ
> Protein counter for drug discovery

Peter So leads a visitor through a seemingly standard biology laboratory, with flasks and beakers lined up on black bench tops; but in a separate part of the lab, the bench tops carry photon counters and lasers in setups cordoned off from one another by heavy black plastic curtains. This is where So, an associate professor of mechanical and biological engineering, and his students perform optics experiments on the biological samples from next door. They are developing new medical-imaging techniques.

The So lab, with six postdocs and seven graduate students, aims to apply the power of optics to areas such as cancer diagnosis and drug discovery. "Optical imaging offers high speed, offers some degree of noninvasiveness, and is probably the only technique that offers submicron resolution," So explains.

So Lab

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Working with Martin Culpepper, an assistant professor of mechanical engineering, So's lab is attempting to develop an endoscope that uses two-photon imaging to find cancer within the body. Human tissue fluoresces naturally when it is stimulated by ultraviolet light. This property can help doctors identify cancerous tissue because the way cells fluoresce depends on factors such as their metabolic state and how much collagen they contain. Unfortunately, So points out, ultraviolet light doesn't reach deep into tissue. Infrared light penetrates much deeper, but infrared photons carry much less energy than ultraviolet photons.

The solution: use two infrared photons that penetrate deeply and deliver an amount of energy similar to that of a single ultraviolet photon—enough to trigger fluorescence. And two-photon imaging reveals more than just the shape of a tumor: it can also provide a spectrographic analysis of tissue, providing information about cells' chemical composition that eludes other forms of imaging.

The group has a grant from MIT's Deshpande Center for Technological Innovation and is seeking National Institutes of Health funding to develop the technology for use with an endoscope that could check for cancers in the throat or colon. The researchers might form a small company to develop such an endoscope. However, So cautions, the need for Food and Drug Administration approval might mean such an instrument would take as long as 15 years to reach clinical use.

Another technique, two-photon 3-D imaging cytometry, is also under development. Combining the penetration ability and the high resolution of infrared photons with a computer program that provides 3-D mapping, the group has been able to create a picture of all the cells in a mouse's heart. "You actually map every single cell in a whole organ," says So. "It's about a terabyte of data."

Cardiologist Richard Lee at Boston's Brigham and Women's Hospital wants to use the technique to study how genes and the enviroment affect heart cells. In many diseases, the heart's muscle cells change shape, but doctors don't fully understand the mechanisms at work. "We'll need to be able to understand three-dimensional structure," Lee says. "Peter's lab really has the ability to enable some really unique approaches to problems."

Oncologist Rakesh Jain, at Massachusetts General Hospital, is using So's technique to study how cancer cells move among bodily organs. To see how well the liver can remove cancer cells from the bloodstream, Jain injects a mouse liver with cancer cells tagged with fluorescent markers and counts the remaining cells daily. Two postdocs from So's lab formed a company called TissueVision and won an NIH grant to develop the system.

The lab doesn't concentrate solely on diagnostic techniques. It has also developed fluorescence correlation spectroscopy for drug discovery. Fluorescent tags are attached to individual proteins, which are then exposed to cellular receptors they might bind to. If the proteins aggregate in one area, researchers can see this by counting the photons they emit. A measure of the binding efficiency of proteins can be important in drug discovery because the aim of the drug might be either to encourage or to prevent such binding, So says.

The pharmaceutical company Novartis had expressed interest in the technique a couple of years ago, So says, but ultimately rejected it because it was too slow. Since then, So's lab has sped up the process a hundredfold. "We think this might put the technique back into play again," he says.

With the development of such new optical probes as quantum dots that shine much more brightly than conventional fluorescent dyes and NIH's recent establishment of the National Institute for Biomedical Imaging and Bioengineering, So expects that his field of optical imaging is going to become the hot new area of medical diagnosis.

DATEBOOK

November 10
Opportunities in Energy Technology

MIT Stata Center, Building 32 Room 123 (Kirsch Auditorium)

ilp-www.mit.edu/display_event.a4d?key=P4&fromKey=P4&eventId=1112

November 12-14
SpaceVision2004 Conference

web.mit.edu/mars/SpaceVision2004

November 16-17
2004 MIT Electronics and Semiconductor Conference

MIT Tang Center

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November 19
MIT Sloan CFO Summit

Newton Marriott

www.mitsacb.com/cfo/

December 7-8

2004 MIT Research and Development Conference: R&D 2005-2010 Challenges and Opportunities

Kresge Auditorium, MIT

ilp-www.mit.edu/display_event.a4d?key=P4&fromKey=P4&eventId=665

Fleshed out

An MIT spinoff that performs rapid 3-D imaging has raised a first round of financing from three venture capital firms. The company, Brontes Technologies in Woburn, MA, has not disclosed how much it raised from Bain Capital Ventures, Charles River Ventures, and IDG Ventures.

Brontes Technology uses its "active wavefront sampling" to form an accurate 3-D image of an object quickly. The company is developing a compact and portable system it hopes will be used for a variety of imaging applications, including some in the medical field.

One of four business ventures to win the first Deshpande Center Innovation Grant from MIT in October 2002, Brontes Technology is the second Deshpande grant winner to raise venture capital. Its core technology was invented at MIT by Douglas Hart, an associate professor of mechanical engineering, János Rohály, a research scientist in mechanical engineering, and doctoral students Federico Frigerio and Sheng Tan. Hart, who is now on the company's board, and Rohály, the company's chief scientist, founded the company along with Eric Paley (now CEO), Micah Rosenbloom (chief operating officer), and Steve Weeks (vice president of engineering).

www.brontes3d.com

Nano millions

The National Institute of Standards and Technology has allocated $2 million for the development of an MIT technology for use in medical imaging. The Advanced Technology Program grant to Quantum Dot in Hayward, CA, will allow the company to develop its quantum dots for imaging eye diseases and cancer in humans.

Quantum dots are tiny crystals of semiconductor material just a few nanometers in diameter. When hit with laser light, the dots fluoresce brightly in colors determined by their size. Experts expect quantum dots to replace the fluorescent dyes now used in medical imaging because they shine much longer and offer a wide palette of colors.

The company's chief scientist, Joseph Treadway, says quantum dots will allow direct imaging of small numbers of cells in degenerative eye diseases, thereby reducing the time it takes to test treatment drugs. The dots will provide better images of cancerous lymph nodes and aid in surgery as well, he says.

Founded in 1998, the company is based on patents by Moungi Bawendi, an MIT chemistry professor, Klavs Jensen, professor of chemical engineering, students Nathan Stott and Sungjee Kim, and former graduate student Frederic Mikulec.

www.qdots.com

Interference pattern

Alnylam Pharmaceuticals has further solidified its patent position by licensing a patent based on work by a former MIT postdoc. The company and Isis Pharmaceuticals have exclusively colicensed patents relating to the therapeutic uses of microRNA. A microRNA is a small, naturally occurring segment of RNA (typically 21 to 24 nucleotides long) that can be used in RNA interference (RNAi), a technique aimed at preventing protein replication. The hope is that RNAi can be used to stop viruses and cancer cells from reproducing.

Alnylam licenses the latest round of intellectual property from the Max Planck Society in Germany. The IP was based on the work of Thomas Tuschl, who later joined the biology lab of David Bartel at MIT's Whitehead Institute for Biomedical Research. Bartel and Tuschl, along with MIT Institute Professor of Biology Phillip Sharp, Whitehead postdoc Phillip Zamore, and others, founded Alnylam in 2002. The Cambridge, MA, company also licenses a portfolio of MIT patent applications based on the work of Robert Langer, Kenneth J. Germeshausen Professor of Chemical and Biomedical Engineering. Alnylam bought Ribopharma, a German developer of RNAi therapies, last year, and since March, Alnylam has been publicly traded.

www.alnylam.com

Sign of the times

E Ink, which uses MIT-invented technology to make electronic paper, is expanding its presence in Asia with licensing agreements with two Japanese companies.

Midori Mark of Tokyo has signed a deal to buy E Ink's ink imaging film and build it into preprogrammed displays of electronic paper. The displays will be sold to retailers worldwide who want to show changeable advertising messages on displays in their stores.

Meanwhile, Toppan Printing, also of Tokyo, will use the technology to manufacture and assemble public signs. Since 2001, Toppan and E Ink have had a strategic alliance to develop displays based on electronic paper.

Electronic paper is a thin substrate coated with changeable pixels and electronic controls. Application of a small voltage changes the image on the paper, which then remains in place indefinitely—even in the absence of electrical power. E Ink was founded in 1997 by Joseph Jacobson, associate professor of media arts and sciences at MIT, and J. D. Albert and Barrett Comiskey, who were students in the Media Lab.

www.eink.com

Deshpande Grants for Technological Innovation

This fall, the MIT Deshpande Center for Technological Innovation awarded eight grants totaling $669,000. The recipients—all faculty members at MIT's School of Engineering—work at the cutting edge of nanotechnology, communications, information technology, medicine, and environmental technology.

AWARDEE	TECHNOLOGY	IMPACT	GRANT
Chiping Chen	Low-cost amplifiers for wireless base stations to make 3G and 4G a reality	The cost of base station amplifiers has been a significant barrier to next-generation wireless deployment. A revolutionary new advance in a decades-old technology—microwave tubes—could change that.	$150,000
Michael Stonebraker	Hybrid database-management systems optimized for read-intensive applications	The system couples a "row store" database engine for efficient updating with a "column store" engine for efficient handling of queries.	$146,000
Klavs Jensen	Integrated automated microchemical laboratories	Tiny labs could make chemical and pharmaceutical development faster, less expensive, and more innovative.	$88,000
Yang Shao-Horn	Engineered electrode assemblies for proton exchange membrane (PEM) fuel cells	A major obstacle to the use of PEM fuel cells in cars and other applications is the prohibitive cost of the electrode assemblies; this technology could solve that problem.	$85,000
John Brisson	Ice cream production method	This cheaper, more energy-efficient way to make ice cream could change large-scale ice-cream production as we know it—and generate a creamier dessert.	$50,000
Clark Colton	Novel contrast agents for enhanced magnetic-resonance imaging to find early-stage cancers	Pinpointing early-stage tumors could dramatically improve the chances of cancer survival.	$50,000
Lionel Kimerling and Anuradha Murthy Agarwal	Low-cost multispectral infrared detector arrays	Commodity-priced multispectral photodetector arrays could unlock the potential of infrared sensors.	$50,000
Martin Culpepper	HexFlex: a six-axis nanomanipulator to enable nanofabrication	This elegant and inexpensive tool for manipulating objects with extreme precision could remove a major obstacle to nanotechnology development.	$50,000

Source: MIT Deshpande Center for Technological Innovation

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The Future of Structural Metals: Lightweight and Super-Strong

CHRISTOPHER SCHUH IS CREATING NEXT-GENERATION ALLOYS THAT ARE HALF THE SIZE OF CONVENTIONAL ALLOYS BUT EQUALLY AS STRONG.

BY CHARLES SCHMIDT

Imagine being able to double the strength of a structural metal without having to increase its size or density. Such a material could be used to make parts half the size of those made with conventional alloys but equally as strong. Sound intriguing? If so, read on: Christopher Schuh, MIT Assistant Professor of Materials Science and Engineering, is creating next-generation alloys with precisely these properties. Derived from a unique marriage of metallurgy and nanotechnology, these revolutionary alloys could drive applications in a nearly limitless array of manufacturing industries. “I see them being used in any application where metal is used as the load-bearing member,” Schuh explains. “The materials are exceptionally strong—up to two giga-pascals compressive strength, which is roughly twice the value you see in traditional steel and titanium alloys.”

Schuh conceived of the new alloys at Lawrence Livermore National Laboratories, where he worked for a year after completing a PhD in materials science at Northwestern University in 2000. He says that at the time, he was looking for a “revolutionary and exciting” opportunity in metallurgy, a classical field that interested him greatly but that wasn’t typically associated with the cutting edge of materials science. Nanotechnology, on the other hand, was driving front-page press while pushing new boundaries in materials applications. By uniting concepts in both fields, Schuh reasoned, he might find the opportunity he was looking for—specifically, a novel breed of alloys whose strength could be increased by virtue of having tailored nanostructures.

THINKING OUTSIDE THE BOX

Arriving at MIT in 2002, Schuh began to put fundamental science behind his ideas, and to tackle them systematically in the laboratory. Nanostructured metals weren’t new in concept, Schuh concedes. Scientists were already pursuing them with a “top-down” approach that seeks to progressively miniaturize the crystalline grains in a standard metal until they reach nanoscale dimensions. By miniaturizing the grains, Schuh explains, scientists introduce increasing amounts of disorder around their external boundaries. The most nanostructured metals—known as glass or amorphous metals—are those whose internal disorder has reached a limit that can’t be exceeded. Top-down approaches are difficult to execute, however, because the metals tend to become thermodynamically unstable as the grains shrink in size.

Schuh decided to reverse the approach with a “bottom-up” philosophy derived from the science of metal-glass forming. To make a metal glass, scientists ordinarily start with two metals of different atomic sizes—for instance, copper and zirconium—and combine them in ratios that produce completely disordered, non-crystalline structures. The mismatch in size is important because it prevents the atoms from packing in an orderly configuration, which is a hallmark of crystalline materials. In his efforts to make a nanostructured metal, Schuh combines alloys of mismatched atoms using electroplating techniques that allow him to precisely control their co-deposition rates. By systematically manipulating co-deposition, he controls the size of the crystals formed and hence the degree of disorder in the metal itself. “My idea is that a glass is somehow related to a nanostructured metal,” Schuh says. “So, whereas the top-down approach takes a traditional metal and refines it—making

CONTINUED ON ILP2

(The Future of Structural Metals, continued from ILP1)

the grains smaller and smaller to observe how the properties change—I take an opposite angle: I start with the total disorder of a glass and then try to take some of that disorder away."

The most optimized material Schuh and his group have created thus far is an alloy based on nickel and tungsten. This particular alloy, he says, is not only nanostructured, it's also stable. The emphasis on stability is critical—highly disordered metals tend to become unstable over long periods of time. "When they are nanostructured, metals are prone to microstructural coarsening," Schuh explains. "That's a big problem; you can make it strong today but in a year it's substantially weaker because the material is evolving. With our nickel alloy, we've produced a material that is not only nanostructured but also happy to remain so."

Assessing material stability is a key aspect of Schuh's research. In these efforts, he's guided by thermodynamic calculations and computer simulations to identify the best alloy compositions. Part of this effort entails the development of new analytic and mathematical models. Conventional knowledge of structure-property relationships won't apply to nanostructured materials, Schuh says. Thus, new physical laws must be discovered to explain their properties. One technique Schuh uses to approach these problems is "instrumented nano-indentation." With this technique, a diamond indenter is pushed into the materials to assess their mechanics at dimensions near the atomic scale. Measurements thus generated provide novel physical insights, which are then interpreted with the help of computer simulations of theoretical metals. "My methods are half theoretical and half experimental," Schuh explains. "We can't do this with trial and error, we have to think about it and get it right on a theoretical basis before we try to make it in the lab."

MOVING FORWARD

Schuh says he views his nanostructured and amorphous metals as "bulk materials," applicable to automotives, aerospace, or any other applications where lightweight, ultra-strong materials are needed. The metals could form blades that keep an edge, springs that retain competitive elastic properties, or high-strength, abrasion-resistant coatings for industrial pipes. A post-doctorate researcher in his laboratory, Pablo Castro, is currently working on abrasion- and corrosion-resistant alloys for such arenas as seawater environments or oil fields. "We think these alloys exhibit a huge potential," Schuh says. "We're not talking about a 10% gain over what we have today—we're looking for a 100%; our ultimate goal is not an incremental improvement but a revolutionary one with respect to these properties."

Schuh is a speaker at the upcoming 2004 MIT Research and Development Conference: R&D 2005-2010 Challenges and Opportunities, hosted by the ILP, where he will give a presentation titled "Nanocrystalline and Amorphous Alloys: Next Generation Structural Metals." The conference will be held at the Kresge Auditorium on the MIT campus on December 7 and 8.

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Srini Devadas (2004 MIT IT Conference, Day 1, 10 a.m.)

» **"The Akamai Story: From Theory to Practice"**
F. Thomson Leighton (2004 MIT IT Conference, Day 2, 12:30 p.m.)

» **"Customer Advocacy: The Key to Marketing Success in the Age of Customer Power"**
Glen Urban (2004 MIT Innovations in Management Conference, Day 2, 11 a.m.)

» **"Framing the Future: How Firms Make Strategic Decisions for Investing in Uncertain Technologies"**
Sarah Kaplan (2004 MIT Innovations in Management Conference, Day 2, 8:45 p.m.)

» **"Putting Healthcare on the Technology Curve"**
John V. Guttag (2004 MIT IT Conference, Day 1, 2 p.m.)

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NEW AND NOTABLE

PROJECTS, LABS, AND CENTERS

MIT'S DESHPANDE CENTER FOR TECHNOLOGICAL INNOVATION AWARDS $669,000 IN GRANTS TO FACULTY RESEARCH PROJECTS

The MIT Deshpande Center has issued eight grants—five new projects and three renewals—from a pool of 34 applicants in its fall round of proposals. The grants, awarded to MIT faculty in the School of Engineering, will fund development of innovations ranging from a new method of early cancer detection to a breakthrough in the cost of manufacturing fuel cells.

http://web.mit.edu/deshpandecenter/release_102504.html
http://web.mit.edu/deshpandecenter/research_fall04grants.html

CRICKET CHIRPING PROVIDES VOICE FOR INTERIOR GPS

What do knowing where to install an electrical outlet, locating your colleague or making a move in a virtual reality game have in common? They are all potential applications for Cricket, an indoor location system developed by Professor Hari Balakrishnan and colleagues at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL).

http://web.mit.edu/newsoffice/2004/cricket-1027.html
http://nms.lcs.mit.edu/projects/cricket/

LAI: SUPPLIER NETWORKS TRANSFORMATION TOOLSET

VERSION 1.0, released March 2004, is an integrated implementation framework for developing lean supplier networks. The Supplier Toolset was developed in response to an important need expressed by the Lean Aerospace Initiative consortium member companies and consists of two integrated modules--Roadmap Tool, and Supplier Management Self-Assessment Tool.

http://lean.mit.edu/Products/subproducts.html
http://lean.mit.edu/Products/products_smat.html

New and Notable

PUBLICATIONS

PURSUING THE ENDLESS FRONTIER: ESSAYS ON MIT AND THE ROLE OF RESEARCH UNIVERSITIES
Charles M. Vest
MIT Press, October 2004

http://mitpress.mit.edu/catalog/item/default.asp?sid=54EA66E4-0B0E-493B-839D-6684036CCC27&ttype=2&tid=10245

"METAL-INSULATOR-SEMICONDUCTOR OPTOELECTRONIC FIBRES"
Bayindir, M., Sorin, F., Abouraddy, A.F., Viens, J., Hart, S.D., John D. Joannopoulos, Yoel Fink
Nature 431, 826-829, October 2004

http://mit-pbg.mit.edu/docs/nature2_fink.pdf

"THE MISALIGNMENT OF PRODUCT ARCHITECTURE AND ORGANIZATIONAL STRUCTURE IN COMPLEX PRODUCT DEVELOPMENT"
Manuel E. Sosa, Steven D. Eppinger, Craig M. Rowles
Sloan School of Management Working Paper 4130, July 2004, forthcoming in *Management Science*

http://www.mit.edu/people/eppinger/abstracts.html#sosa4 (abstract)
http://www.mit.edu/people/eppinger/pdf/Sosa_MS2004.pdf (article)

"GIST OF A SCENE"
Aude Oliva
In Neurobiology of Attention, Eds. L. Itti, G. Rees and J. Tsotsos
Academic Press, Elsevier (in press)

http://cvcl.mit.edu/Papers/Oliva04.pdf

CONFERENCES

NOVEMBER 16-17, 2004
2004 MIT Electronics and Semiconductor Conference: Leveraging 21st Century Electronics
ILP Conference, MIT Series on Technology and the Corporation
Wong Auditorium, Building E51, MIT Campus

http://ilp-www.mit.edu/events/E&S2004/

DECEMBER 7-8, 2004
2004 Research & Development Conference
ILP Conference, MIT Series on Technology and the Corporation
Wong Auditorium, Building E51, MIT Campus

http://ilp-www.mit.edu/events/RD2004/

JANUARY 21, 2005
7th Annual MIT in Japan Symposium
Tokyo, Japan

http://ilp-www.mit.edu/display_event_agenda.a4d?eventId=667&key=P4b&event=667

MARCH 9-10, 2005
2005 MIT Life Sciences Conference
Wong Auditorium, Building E51, MIT Campus

http://ilp-www.mit.edu/display_event.a4d?key=P4b&eventId=668

EVENTS

NOVEMBER 19, 2004, 8:00A.M. - 6:00P.M.
Competing in a Changing World: Globalization, Leadership, and Risk
Newton Marriott Hotel, Newton, MA
Sloan Alumni Club of Boston, in association with Business Finance Magazine and Massachusetts Society of CPA's

http://www.mitsacb.com/cfo/

NOVEMBER 19 - 20, 2004
14th Annual Fall Workshop on Computational Geometry
MIT Computer Science & Artificial Intelligence Laboratory (CSAIL)
Stata Center, Building 32, Room 141
(32 Vassar Street), MIT Campus

http://cgw2004.csail.mit.edu/

DECEMBER 3, 2004
1st Annual Global TIES* Conference: High-Tech Entrepreneurship & Cluster Development
*TIES = Technology, Innovation & Entrepreneurship Series
MIT Sloan Asian Business Club
MIT Campus Location TBD

http://web.mit.edu/sloanabc/www/events/2004-04-30_Global_TIES.html

MARCH 20-23, 2005
Alliance for Global Sustainability Annual Meeting
MIT Campus

http://web.mit.edu/agsam2005/
http://globalsustainability.org

The Industrial Liaison Program Presents:
MIT SERIES ON TECHNOLOGY AND THE CORPORATION

December 7-8, 2004. Kresge Auditorium
MIT Campus

- Capitalizing on Technology's Big Os - NanO, BiO, InfO and EnvirO
- Creating, Commercializing new Technologies through Collaboration
- Leveraging U.S. Leadership Role in Space and Defense
- Outsourcing R&D for Strategic Advantage
- Adapting the Workplace to the New Order of Business

ilp-www.mit.edu/events/RD2004/