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Career Cornerstone News

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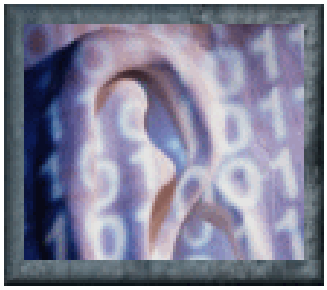


Career Cornerstone News is a Publication of the Sloan Career Cornerstone Center, the Premier Online Resource for Exploring Career Paths in Science, Technology, Engineering, Mathematics, Computing, and Medicine.

Inside this issue:

Neurostimulator Epilepsy Device

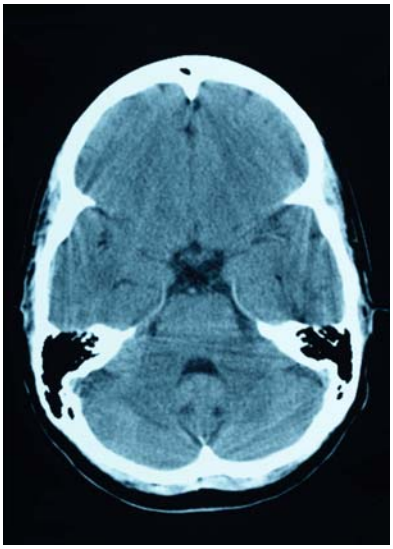
Neurologists at Mayo Clinic in Jacksonville, FL, are enrolling patients with epilepsy in the next phase of a clinical research trial to further determine the safety and efficacy of a surgically implanted device that detects brain seizure activity and may suppress seizures before they start.

The device, called a responsive neurotransmitter, acts like a pacemaker for the brain. It may be implanted in some patients with frequent, disabling seizures who have failed treatment with at least two anti-epileptic medications.

A Mayo Clinic neurosurgeon implants the self-contained device, not much bigger than a watch, under the scalp of eligible patients.

The neurosurgeon then connects the responsive neurostimulator to wires placed in the region or regions of the brain where seizure activity occurs.

The neurostimulator constantly monitors the brain's electrical activity for onset of seizure activity. When seizure activity is detected, the neurostimulator delivers mild electrical stimulation through the wires in an attempt to stop the seizure before the patient experiences symptoms.



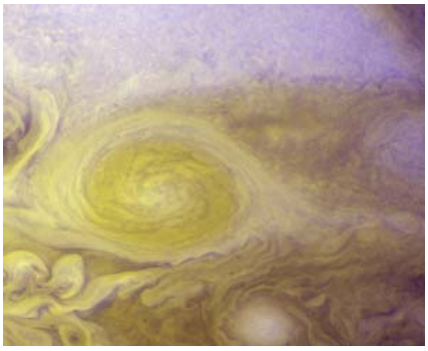
More details are at www.mayoclinic.org.

Glimpses of Jupiter

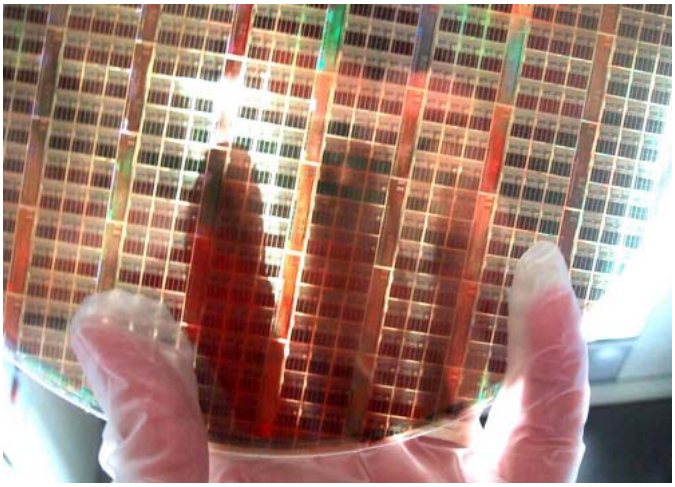
NASA's New Horizons spacecraft has provided new data on the Jupiter system, stunning scientists with never-before-seen perspectives of the giant planet's atmosphere, rings, moons and magnetosphere.

These new views include the closest look yet at the Earth-sized "Little Red Spot" storm churning materials through Jupiter's cloud tops; detailed images of small satellites herding dust and boulders through Jupiter's faint rings; and of volcanic eruptions and circular grooves on the planet's largest moons.

New Horizons came to within 1.4 million miles of Jupiter earlier this year, using the planet's gravity to trim three years from its travel time to Pluto. For several weeks before and after this closest approach, the piano-sized robotic probe trained its seven cameras and sensors on Jupiter and its four largest moons, storing data from nearly 700 observations on its digital recorders and gradually sending that information back to Earth. The images were radioed to NASA's largest antennas over more than 600 million miles. The image above is of Jupiers "little red spot." This activity confirmed the successful testing of the instruments and operating software the spacecraft will use at Pluto.



3-D Chip Stacking Manufacturing Technique



IBM has announced a breakthrough chip-stacking technology in a manufacturing environment that paves the way for three-dimensional chips that will extend Moore's Law beyond its expected limits. The technology – called "through-silicon vias" -- allows different chip components to be packaged much closer together for faster, smaller, and lower-power systems.

The IBM breakthrough enables the move from horizontal 2-D chip layouts to 3-D chip stacking, which takes chips and memory devices that traditionally sit side by side on a silicon wafer and stacks them together on top of one another. The result is a compact sandwich of components that dramatically reduces the size of the overall chip package and boosts the speed at which data flows among the functions on the chip.

The first application of this through-silicon via technology will be in wireless communications chips that will go into power amplifiers for wireless LAN and cellular applications.

IBM has been researching 3-D stacking technology for more than a decade at the IBM T.J. Watson Research Center and now at its labs around the world.

Find out more at www.ibm.com/chips.

Degree Profile: Petroleum Engineering

Petroleum engineers search the world for reservoirs containing oil or natural gas. Once these resources are discovered, petroleum engineers work with geologists and other specialists to understand the geologic formation and properties of the rock containing the reservoir, determine the drilling methods to be used, and monitor drilling and production operations. They design equipment and processes to achieve the maximum profitable recovery of oil and gas. Petroleum engineers rely heavily on computer models to simulate reservoir performance using different recovery techniques. They also use computer models for simulations of the effects of various drilling options.

Because only a small proportion of oil and gas in a reservoir will flow out under natural forces, petroleum engineers develop and use various enhanced recovery methods. These include injecting water, chemicals, gases, or steam into an oil reservoir to force out more of the oil, and computer-controlled drilling or fracturing to connect a larger area of a reservoir to a single well. Because even the best techniques in use today recover only a portion of the oil and gas in a reservoir, petroleum engineers research and develop technology and methods to increase recovery and lower the cost of drilling and production operations.

Find out more about careers in Petroleum Engineering at www.careercornerstone.org.

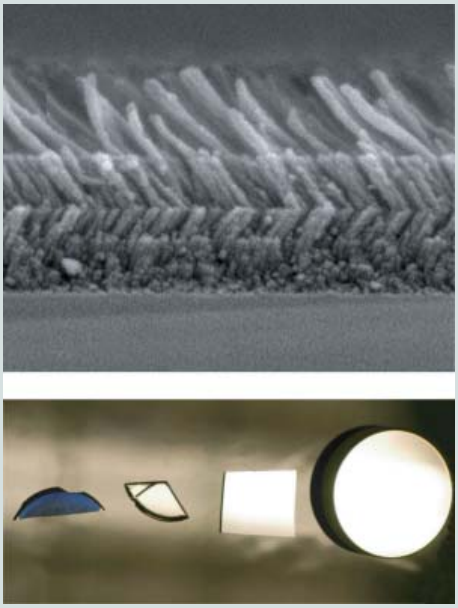
Black Hole for Reflections

Researchers have created an anti-reflective coating that allows light to travel through it, but lets almost none bounce off its surface. At least 10 times more effective than the coating on sunglasses or computer monitors, the material, which is made of silica nanorods, may be used to channel light into solar cells or allow more photons to surge through the surface of a light-emitting diode (LED). Jong Kyu Kim and a team from Rensselaer Polytechnic Institute in Troy, NY, crafted the coating, which reflects almost as little light as do molecules of air. Guided by National Science Foundation-supported electrical engineer Fred Schubert, the researchers developed a process based on an already common method for depositing layers of silica, the building block of quartz, onto computer chips and other surfaces. The method grows ranks of nanoscale rods that lie at the same angle. That degree of the angle is determined by temperature.

Under a microscope, the films look like tiny slices of shag carpet. By laying down multiple layers, each at a different angle, the researchers created thin films that are uniquely capable of controlling light. With the right layers in the right configuration, the researchers believe they can even create a film that will reflect no light at all.

One critical application for the material is in the development of next-generation solar cells. By preventing reflections, the coating would allow more light, and more wavelengths of light, to transmit through the protective finish on a solar cell surface and into the cell itself. Engineers may be able to use such a technique to boost the amount of energy a cell can collect, bypassing current efficiency limits.

Another application would involve coating LEDs to eliminate reflections that cut down the amount of light the LED can emit. The researchers hope the efficiency gains could allow the light sources to compete more effectively with fluorescent and incandescent bulbs. So, they will next focus their attention on solid state lighting. Find out more at www.rpi.edu/~schubert.



Layers of silica nanorods look like shag carpet (top) when viewed with a scanning electron microscope. When coated on a surface (bottom), the new anti-reflective material looks dark (left) in contrast to other anti-reflective coatings.
Credit: E. Fred Schubert and Jong Kyu Kim,

Career Cornerstone Explores Career Paths in...

- **Actuarial Science**
- **Aerospace Engineering**
- **Agricultural Engineering**
- **Architectural Engineering**
- **Bioengineering**
- **Biology**
- **Chemical Engineering**
- **Chemistry**
- **Civil Engineering**
- **Computer Engineering**
- **Computer Science**
- **Dentistry**
- **Electrical Engineering**
- **Engineering Technology**
- **Environmental Engineering**
- **Geosciences**
- **Industrial Engineering**
- **Manufacturing Engineering**
- **Materials Science and Engineering**
- **Mathematics**
- **Mechanical Engineering**
- **Medicine**
- **Mining Engineering**
- **Nuclear Engineering**
- **Nursing**
- **Petroleum Engineering**
- **Physics**
- **Software Engineering**
- **Statistics**
- **Veterinary Science**

- - - and more to come...

Students Benefit from Undergrad Research

Undergraduate students who participate in hands-on research are more likely to pursue advanced degrees and careers in science, technology, engineering and mathematics (STEM) fields, according to a new study. The study's authors state that National Science Foundation (NSF) and other entities' efforts to encourage representation of underrepresented groups in STEM fields appear to be effective. For example, students who entered 2-year colleges were as likely as those who entered 4-year colleges or universities to participate in research. And undergraduate researchers were more likely than non-researchers to pursue a doctorate.

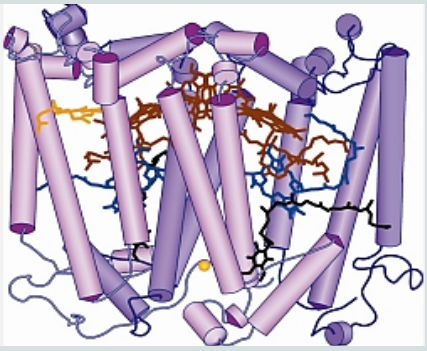
"This study indicates that carefully designed undergraduate research experiences motivate students," said Myles Boylan, program director for NSF's Course, Curriculum and Laboratory Improvement Program in the Divisions of Undergraduate Education and Graduate Education. "Students consider their research experiences to be effective previews of doing STEM graduate work as well as good learning experiences."

Brittney Perry participates in an undergraduate research program in Armand Tanguay's laboratory at the University of Southern California.
Credit: Biomimetic MicroElectronic Systems Engineering Research Center

The authors conclude that given the positive outcomes of undergraduate research opportunities (UROs), greater attention should be given to fostering STEM interest in students at the elementary and high school levels. The study resulted from a series of surveys on UROs funded by eight NSF programs with a substantial undergraduate research component. The full report is available at www.sri.com/policy/csted/reports/university/documents/URO%20FollowupSurveyRpt.

Scientists Offer New View of Photosynthesis

During the remarkable cascade of events in photosynthesis, plants approach the pinnacle of stinginess by scavenging nearly every photon of available light energy to produce food. Yet after many years of careful research into the exact mechanisms, some key questions remain about this fundamental biological process that supports almost all life on Earth. Now a research team led by Neal Woodbury, a scientist at the Arizona State University (ASU) Biodesign Institute, has come up with a new insight into the mechanism of photosynthesis. The discovery involves the orchestrated movement of proteins on the timescale of a millionth of a millionth of a second. The researchers focused their efforts on studying the center stage of photosynthesis, the reaction center, where light energy is funneled into specialized chlorophyll-binding proteins. Wang used ASU's ultrafast laser facility, funded by NSF, which acts like a high-speed motion picture camera that can capture data from these lightning-fast reactions. The movement of the reaction center proteins during photosynthesis allows a plant or bacteria to harness light energy efficiently, even if conditions aren't optimal. The research is could be valuable in the design of organic solar cells. The efficiency of energy conversion by photosynthesis is much higher than traditional solar devices. Find out more at www.biodesign.asu.edu.



Biologists have discovered that a split-second, highly orchestrated process drives photosynthesis.
Credit: Arizona State University