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Career Cornerstone News

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

Inside this issue:

How the Sun Stores and Releases Energy

A NASA suborbital telescope has given scientists the first clear evidence of energy transfer from the sun's magnetic field to the solar atmosphere or corona. This process, known as solar braiding, has been theorized by researchers, but remained unobserved until now. Researchers were able to witness this phenomenon in the highest resolution images ever taken of the solar corona. These images were obtained by the agency's High Resolution Coronal Imager (Hi-C) telescope, which was launched in July 2012. "Because of the level of solar activity, we were able to clearly focus on an active sunspot, and obtain some remarkable images. Seeing this for the first time is a major advance in understanding how our sun continuously generates the vast amount of energy needed to heat its atmosphere," said Hi-C principal investigator Jonathan Cirtain, a heliophysicist at NASA's Marshall Space Flight Center. The telescope, the centerpiece of a payload weighing 464 pounds and measuring 10-feet long, flew for about 10 minutes and captured 165 images of a large, active region in the sun's corona. The telescope acquired data for five minutes, taking one image every five seconds.

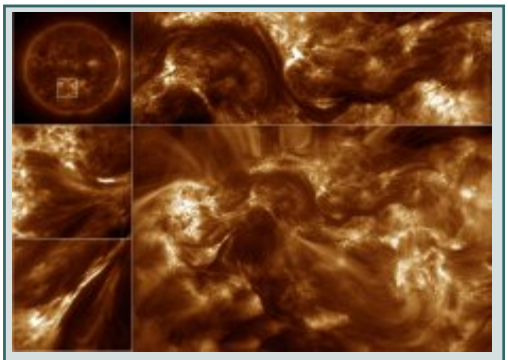


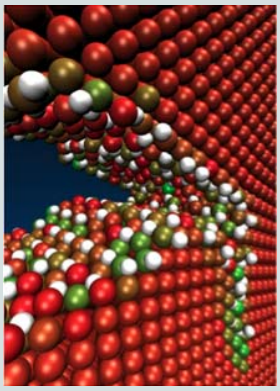
Image Credit: NASA

Find out more about careers in physics at www.careercornerstone.org.

Hydrogen Embrittlement Clues

Hydrogen, the lightest element, can easily dissolve and migrate within metals to make these otherwise ductile materials brittle and substantially more prone to failures.

Hydrogen embrittlement has been a persistent problem for the design of structural materials in various industries, from battleships to aircraft and nuclear reactors. Despite decades of research, experts have yet to fully understand the physics underlying the problem or to develop a rigorous model for predicting when, where and how hydrogen embrittlement will occur. Now, Jun Song, an Assistant Professor in Materials Engineering at McGill University, and Prof. William Curtin, Director of the Institute of Mechanical Engineering at École polytechnique fédérale de Lausanne in Switzerland, have shown that the answer to hydrogen embrittlement may be rooted in how hydrogen modifies material behaviours at the nanoscale. In a recent study, Song and Curtin presented a new model that can accurately predict the occurrence of hydrogen embrittlement.



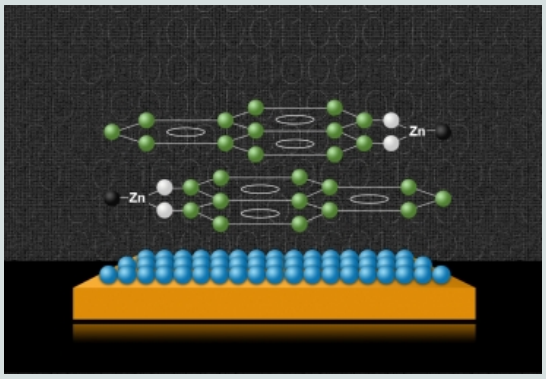
(Image Credit: McGill University)

Storing Data in Individual Molecules

Moore's law — the well-known doubling of computer chips' computational power every 18 months or so — has been paced by a similarly steady increase in the storage capacity of disk drives. In 1980, a hard drive could store about a half-megabyte of data in a square inch of disk space; now, manufacturers are closing in on a million megabytes of data per square inch.

An experimental technology called molecular memory, which would store data in individual molecules, promises another 1,000-fold increase in storage density. Previous schemes for molecular memory have relied on physical systems cooled to near absolute zero. Now, an international team of researchers at MIT and the Indian Institute of Science Education and Research in Kolkata have described a new molecular-memory scheme that works at around the freezing point of water — which in physics parlance counts as "room temperature."

Where previous schemes required sandwiching the storage molecules between two ferromagnetic electrodes, the new scheme would require only one ferromagnetic electrode. That could greatly simplify manufacture, as could the shape of the storage molecules themselves: because they consist of flat sheets of carbon atoms attached to zinc atoms, they can be deposited in very thin layers with very precise arrangements.

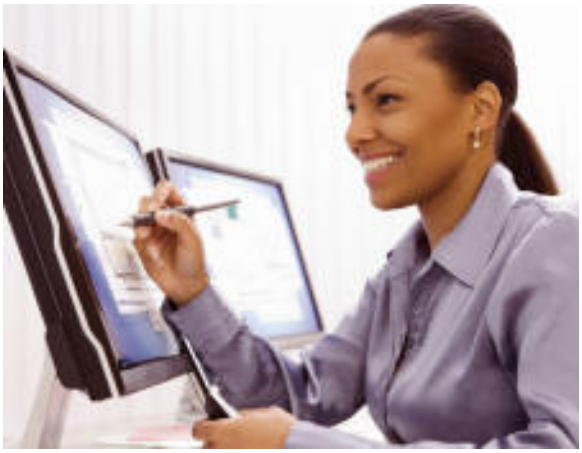


The new molecules are known as 'graphene fragments,' because they largely consist of flat sheets of carbon (which are attached to zinc atoms). That makes them easier to align during deposition, which could simplify the manufacture of molecular memories.
Graphic: Christine Daniloff/MIT

Degree Profile: Medical Records Technicians

Medical records and health information technicians assemble patients' health information including medical history, symptoms, examination results, diagnostic tests, treatment methods, and all other healthcare provider services. Technicians organize and manage health information data by ensuring its quality, accuracy, accessibility, and security. They regularly communicate with physicians and other healthcare professionals to clarify diagnoses or to obtain additional information. The increasing use of electronic health records (EHR) will continue to broaden and alter the job responsibilities of health information technicians.

Medical records and health information technicians generally obtain an associate degree from a community or junior college. Typically, community and junior colleges offer flexible course scheduling or online distance learning courses. In addition to general education, coursework includes medical terminology, anatomy and physiology, legal aspects of health information, health data standards, coding and abstraction of data, statistics, database management, quality improvement methods, and computer science. Applicants can improve their chances of admission into a program by taking biology, math, chemistry, health, and computer science courses in high school.

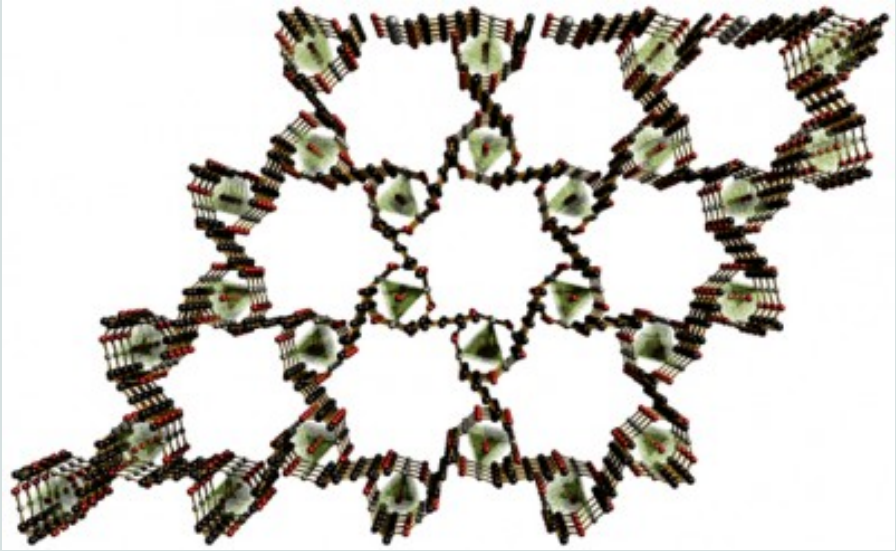


Median earnings of medical records and health information technicians are $30,610. The middle 50 percent earned between $24,290 and $39,490. The highest 10 percent earned more than $50,060. In terms of employment, medical records and health information technicians hold about 172,500 jobs in the United States. About 39 percent of jobs were in hospitals. Health information technicians work at a number of healthcare providers such as offices of physicians, nursing care facilities, outpatient care centers, and home healthcare services. Technicians also may be employed outside of healthcare facilities, such as in Federal Government agencies.

Find out more about a career as a medical record technician at www.careercornerstone.org.

Nanosponge Filters Out Herbicide Poisons

New research has demonstrated the potential of a new kind of nanomaterial to filter out environmental toxins in water.
A team of researchers led by Dr Mainak Majumder and Phillip Sheath from Monash University's Department of Mechanical Engineering and Dr Matthew Hill from CSIRO have developed a highly-porous Metal Organic Framework (MOF) that, almost uniquely, is stable and able to filter substances in water. MOFs are clusters of metal atoms connected by organic molecules and known for their exceptional abilities to store or separate gases such as carbon dioxide. This is one of the first studies to demonstrate their separation applications in an aqueous environment.



A new metal organic framework can effectively filter toxins from water. (Image Credit: Monash University)

Dr Majumder said the uniform structure of MOFs made them very efficient filters.
"These are crystalline materials with a difference - they have pores that are all exactly the same size. So while one substance can fit in the pores and be captured, another, just one tenth of a nanometre bigger, can't fit," Dr Majumder said.

"As a result you can detect and capture substances that are present in low concentrations, or in a mixture with other materials."

The researchers demonstrated the filtering ability of the new MOF by sieving paraquat - a herbicide that has been linked with the onset of Parkinson's Disease. The MOF was a very precise filter, removing paraquat, but leaving other contaminants.

"Because MOFs are flexible, we found that their structure changed when they absorbed the paraquat. This means that our MOF could form the basis of a device for quickly and easily testing for the contaminant in water," Dr Hill said. "Due to its very precise filtering properties, this testing application could deliver very accurate contamination readings in the field." Only one contaminant, paraquat, was tested in this study; however, the MOF could be altered to filter out other contaminants.

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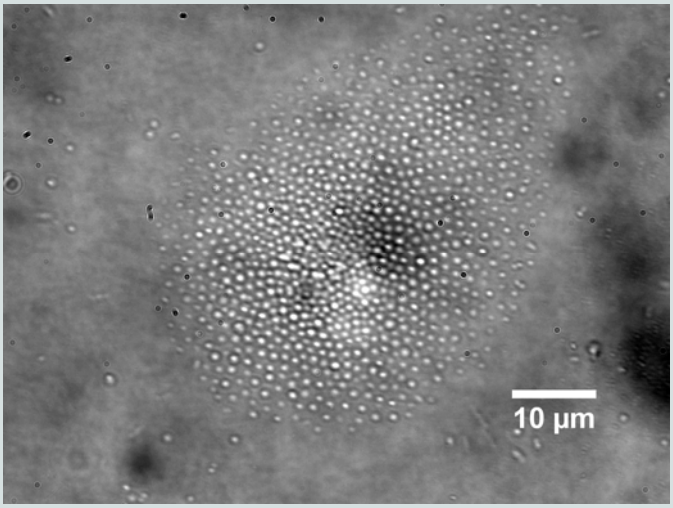
Biochip's Tiny Whirlpools Corral Microbes

Researchers have demonstrated a new technology that combines a laser and electric fields to create tiny centrifuge-like whirlpools to separate particles and microbes by size, a potential lab-on-a-chip system for medicine and research. The theory behind the technology, called rapid electrokinetic patterning - or REP - has been described in technical papers published between 2008 and 2011. Now the researchers have used the method for the first time to collect microscopic bacteria and fungi, said Steven T. Wereley, a Purdue University professor of mechanical engineering.

The technology could bring innovative sensors and analytical devices for lab-on-a-chip applications, or miniature instruments that perform measurements normally requiring large laboratory equipment. REP is a potential new tool for applications including medical diagnostics; testing food, water and contaminated soil; isolating DNA for gene sequencing; crime-scene forensics; and pharmaceutical manufacturing.

The technology works by using a highly focused infrared laser to heat fluid in a microchannel containing particles or bacteria. An electric field is applied, combining with the laser's heating action to circulate the fluid in a "microfluidic vortex," whirling mini-maelstroms one-tenth the width of a human hair that work like a centrifuge to isolate specific types of particles based on size.



Here the rapid electrokinetic patterning technique is used to arrange bacteria into a specific pattern.
(Image Credit: Purdue University)

Particles of different sizes can be isolated by changing the electrical frequency, and the vortex moves wherever the laser is pointed, representing a method for positioning specific types of particles for detection and analysis.

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Top Paying Majors Focus on Technology

Technical majors—particularly those in engineering—dominated the list of top-paying majors in 2012, according to a new report by the National Association of Colleges and Employers (NACE). NACE's January 2013 Salary Survey found that six engineering majors were among the 10 highest-paid at the bachelor's-degree level. "This is not surprising since the supply of these graduates is low, but the demand for them is so high," says Marilyn Mackes, NACE executive director.

At an average starting salary of $70,400, computer engineering was the highest-paid major in 2012. Other engineering majors that were among the top 10 were chemical engineering, ($66,400, second), aerospace/aeronautical/astronautical engineering ($64,000, fourth), mechanical engineering ($62,900, fifth), electrical/electronics and communications engineering ($62,300, sixth), and civil engineering ($57,600, seventh).

Computer science majors earned starting salaries that averaged $64,400, the third most among bachelor's-degree graduates in 2012. Other non-engineering majors whose average starting salaries were among the highest were finance ($57,300, eighth), construction science/management ($56,600, ninth), and information sciences and systems ($56,100, 10th).

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