AVS 58th International Symposium and Exhibition: Highlights and media registration

EurekAlert

The AVS 58th International Symposium & Exhibition will be held Oct. 30 - Nov. 4, 2011, at the Nashville Convention Center in Nashville, Tenn. More than 1,200 talks will be delivered on cutting-edge issues covering new energy frontiers, graphene and related materials, nanomanufacturing, printable electronics, and more. The event will also feature two evenings of poster presentations and an exhibition featuring related equipment and services. AVS offers complimentary press registration to journalists. Registration information can be found at the end of this release. Journalists may also remotely access meeting information through AVS's online pressroom.

The following summaries are highlights of the meeting's many talks.

HIGHLIGHTS: MONDAY, OCTOBER 31

Hey, bacteria, get off of my boat!

Opportunistic seaweed, barnacles, and bacterial films can quickly befoul almost any underwater surface, but researchers are now using advances in nanotechnology and materials science to design environmentally friendly underwater coatings that repel these biological stowaways. Biological build-up on the undersides of boats can increase drag, adding to fuel costs, and colonies of sea life can also disrupt the operation of ocean sensors and other underwater equipment. Anti-fouling paints, designed to kill the colonizers, often contain heavy metals or other toxic chemicals that might accumulate in the environment and unintentionally harm fish or other marine organisms. To replace toxic paints, scientists and engineers are now looking for ways to manipulate the physical properties of surface coatings to discourage biological colonization. The researchers, led by Gabriel Lopez of Duke University, focused on a class of materials called stimuli-responsive surfaces that alter their physical or chemical properties in response to a stimulus, such as a temperature change. Currently the group experiments on two different types of stimuli-responsive surfaces: one that changes its texture in response to temperature, and the other in response to an applied voltage. When the surface is exposed to the appropriate stimuli, it will wrinkle on the micro- or nano-scale, shaking off slimy colonies of marine bacteria in a manner similar to how a horse might twitch its skin to shoo away flies.

Presentation MB-MoM-9, "Micro to Nanostructured Stimuli-Responsive Surfaces for Study and Control of Bioadhesion," is at 11 a.m. on Monday, Oct. 31.

Being clean: It's more than getting rid of bacteria

Even after bacteria have been killed, the biomolecules they leave behind can still cause illness. Researchers at the University of California at Berkeley and the University of Maryland at College Park have teamed up to study how low-temperature plasmas can deactivate these potentially dangerous biomolecules, which may be left behind by conventional sterilization methods.

"Bacteria are known to create virulence factors – biomolecules expressed and secreted by pathogens – even if they have been killed," says David Graves, a professor working on the research at UC Berkeley's Department of Chemical and Biomolecular Engineering. Conventional sterilization methods, such as heating surgical equipment in an autoclave, can't effectively combat these molecules, which can cause severe medical problems. One example of such a biomolecule is lipopolysaccharide (LPS). Found in the membranes of E. coli bacteria, LPS can cause fever, low blood pressure, and breathing problems, and may even lead to multiple organ failure and death. Graves' research team is using a vacuum-beam system to study Lipid A, the major immune-stimulating region of LPS. The team's results suggest that plasma-generated vacuum ultraviolet light can reduce the toxicity of Lipid A. Their work is another step toward a clearer understanding of how low-temperature plasmas work and a good indication that "clean" can indeed be redefined.

Presentation PS+BI-MoA-10, "Plasma Deactivation of Pyrogenic Biomolecules: Vacuum Ultraviolet Photon and Radical Beam Effects on Lipid A," will be presented by Graves's doctoral student, Ting-Ling Chung, at 5 p.m. on Monday, Oct. 31.

HIGHLIGHTS: TUESDAY, NOVEMBER 1

Aiming for inexpensive hydrogen storage

A team of researchers has discovered that, with a minor modification, inexpensive aluminum is able to both break apart molecular hydrogen and capture the individual atoms, potentially leading to a robust and affordable fuel storage system. As a potential fuel, molecular hydrogen must be stored under great pressure and at very low temperatures. An alternative storage solution is a material that could efficiently hold individual hydrogen atoms and release them on demand. This solution requires breaking the chemical bonds between two hydrogen atoms, a process known as hydrogen activation, and is typically accomplished with the help of an expensive "noble metal" catalyst. In the quest to find an equally efficient, yet less-expensive, alternative, lead researcher Yves J. Chabal of the University of Texas at Dallas and Santanu Chaudhuri at Washington State University decided to experiment with aluminum. Under normal conditions aluminum doesn't react with molecular hydrogen, but a way to unlock its storage potential, the researchers discovered, is to impregnate its surface with the metal titanium. Their studies revealed that in areas doped with titanium, atomic hydrogen was being produced on the aluminum surface. The titanium then further advanced the process by helping the hydrogen bind to the aluminum to form aluminum hydride. If used as a fuel-storage device, the aluminum hydride could be made to release its store of hydrogen by simply raising its temperature. "Although titanium may not be the best catalytic center for fully reversible aluminum hydride formation, the results prove for the first time that titanium-doped aluminum can activate hydrogen in ways that are comparable to expensive and less-abundant catalyst metals such as palladium and other near-surface alloys consisting of similar noble metals and their bimetallic analogs," Chaudhuri explains.

Presentation SS1-TuM-4 "Turning Aluminum into a Noble-metal like Catalyst for Low Temperature Molecular Hydrogen Activation," will be presented by Irinder Chopra, the lead student on the project, at 9a.m. on Tuesday, Nov. 1.

Ready for their close-up: Proteins caught 'in action' in intact cells using new electron microscopy technique

Researchers at Vanderbilt University in Nashville, Tenn., have come up with a promising new technique that uses a scanning transmission electron microscope (STEM) to view proteins tagged with gold nanoparticles in whole cells. Determining the locations of proteins in a whole cell could help researchers study cancer processes, as well as understand how viruses break into healthy cells and hijack them. Modern methods of studying protein interactions have limitations: optical microscopes can capture sweeping vistas of whole, live cells, but the devices are not sensitive enough to zoom in for a close-up on individual proteins. Transmission electron microscopes (TEM), on the other hand, can resolve the locations of individual proteins; but eukaryotic cells have to be sliced into thin sections to be viewed this way. To detect proteins in a whole cell, the Vanderbilt scientists took advantage of a STEM analysis technique called annular dark-field (ADF) imaging. ADF detectors are sensitive to heavy elements like gold, lead, and platinum, and much less sensitive to materials like water and carbon – the main components of a cell. By tagging proteins with gold nanoparticles, the researchers made the proteins stand out in strong relief from the otherwise signal-less cellular environment. Though no longer alive, the cells are preserved in as natural a state as possible, surrounded by liquid that is enclosed by a microchip device that can withstand the vacuum of the STEM. To date, the team has achieved a resolution of about 4 nanometers – ten times better than state-of-the-art fluorescence microscopy. The benefits of the new technique could extend beyond biology to the energy and materials sciences, too, giving researchers tools that could help them design better car batteries, for example.

Presentation IS+AS+SS-TuM3, "Imaging Tagged Proteins in Whole Eukaryotic Cells in Liquid with Scanning Transmission Electron Microscopy," is at 8:40 a.m. on Tuesday, Nov. 1.

HIGHLIGHTS: WEDNESDAY, NOVEMBER 2

Graphene applications in electronics and photonics

Graphene, which is made of a one-atom-thick layer of carbon atoms in a honeycomb-like lattice, is the world's thinnest material – and one of the hardest and strongest. Phaedon Avouris, manager of the Nanometer Scale Science and Technology division at IBM's T.J. Watson Research Center in Yorktown Heights, N.Y., and his group strive to understand how graphene behaves in real-world technology applications and to use that knowledge to design, build, and test graphene-based devices and circuits. "While graphene has a number of extremely useful properties, including very fast electron mobility, high mechanical strength, and excellent thermal conductivity, the interactions of graphene with its environment – for example, with the substrate it is placed on, the ambient environment, or other materials in a device structure – can drastically affect and change its intrinsic properties," Avouris says. Going forward, graphene researchers need to improve the quality of synthetic graphene and to study its properties under conditions relevant to technology, says Avouris, who is "very optimistic" about the future of graphene in both electronics and photonics and anticipates the development of additional new applications.

Presentation NS-WeM-4 "Graphene-based Electronics and Optoelectronics" is at 9 a.m. on Wednesday, Nov. 2.

"Ay, there's the rub": Researchers strive to identify the atomic origins of wear

"Wear is so common in sliding systems that it has acquired this air of inevitability," says Greg Sawyer, a professor in mechanical engineering at the University of Florida who leads a team of researchers hoping to overturn this assumption. Sawyer and his collaborators have succeeded in modifying polytetrafluoroethylene (PTFE), the ubiquitous, already low-friction material also known as Teflon, to make it "nearly a million times more wear-resistant." By applying the lessons learned from this and other such success stories, the researchers are attempting to identify, and then eliminate, the atomic and molecular origins of wear. Sawyer and his team have come up with a number of hypotheses to explain how frictional forces might rip off or grind away bits of material in particular sliding systems. To test their hypotheses, the scientists use atomic force microscopes to create atomic-scale images of surfaces and use finely tuned instruments to measure the minute forces that occur as materials slide against each other. Once the researchers identify a factor that contributes to system wear, they try to design a way to stop it. In the instance of the ultra-low-wear PTFE, the researchers embedded alumina nano-particles in the polymer, which dramatically reduced wear. And this effect isn't limited to PTFE. Other nano-particle-filled plastic composites have been shown to display a decreased sliding coefficient of friction, although scientists are still investigating the precise mechanisms that result in the reduced wear. Sawyer's team studies a number of low-wear systems, including polymers, metals, and ceramics.

Presentation TR-WeA7, "Going No Wear?," is at 4 p.m. on Wednesday, Nov. 2.

Chemical engineers decipher mystery of neurofibrillary tangle formation in Alzheimer's brains

Neurofibrillary tangles – odd, twisted clumps of protein found within nerve cells – are a pathological hallmark of Alzheimer's disease. Now, new research by Eva Chi, an assistant professor of chemical engineering at the University of New Mexico, and her colleagues suggests that changes to the lipid membranes of nerve cells initiate tangle formation. "Proteins in the brain do not aggregate spontaneously to form amyloid fibrils to cause diseases," says Chi. Rather, she explains, "there are physiological triggers that cause these proteins to start aggregating and the lipid membrane may serve such a role." Using a combination of techniques, including fluorescence microscopy and X-ray and neutron scattering imaging, Chi and her colleagues found that tau proteins inside nerve cells interact strongly with negatively charged lipids, which are found on the inner surface of cell membranes. When tau proteins interact with the lipid membrane, they can damage the structure of the membrane, "which can possibly make the membranes 'leaky' and cause neurons to die," Chi explains. "There has been much uncertainly about what causes neurodegeneration in these diseases, but now the field is converging on the idea that neuronal death in Alzheimer's disease is caused by the proteins acquiring toxicity as they aggregate." The research suggests that compounds that prevent the proteins from interacting with the lipid membrane – or protect the membrane from being disrupted – could offer hope to Alzheimer's patients.

Presentation NT+AS-WeA8, "Interaction of Alzheimer's Disease Tau Protein with Model Lipid Membranes," is at 4:20 p.m. on Wednesday, Nov. 2.

HIGHLIGHTS: THURSDAY, NOVEMBER 3

Plutonium's unusual interactions with clay may minimize leakage of nuclear waste

As a first line of defense, steel barrels buried deep underground are designed to keep dangerous plutonium waste from seeping into the soil and surrounding bedrock. But after several thousand years, those barrels will naturally begin to disintegrate due to corrosion. A team of scientists at Argonne National Lab (ANL) in Argonne, Ill., have determined what may happen to this toxic waste once its container disappears. With its half-life of 24 thousand years, plutonium is notoriously difficult to work with, and the result is that very little is known about its chemistry. Also, unlike other ions, plutonium bunches into nanometer-sized clusters in water, and almost nothing is known about how these clusters interact with clay surfaces. Using a range of X-ray scattering techniques, the Argonne team reconstructed images of thin layers of plutonium molecules sitting on the surface of a mineral called muscovite. The scientists discovered that nanoclusters of plutonium adhere much more strongly to mineral surfaces than individual plutonium ions would be expected to. The result is that plutonium tends to become trapped on the surface of the clay – a process that could help contain the spread of plutonium into the environment. These are fundamental studies, the researchers caution, and probably will not have an immediate impact on the design of plutonium-containing structures; however, they say, this work shows the importance of studying plutonium's surface reactivity at a molecular level, with potential future benefits for nuclear waste containment strategies. Presentation AC+TF-ThA-1, "Plutonium Sorption and Reactivity at the Solid/Water Interface," is at 2 p.m. on Thursday, Nov. 3.

HIGHLIGHTS: FRIDAY, NOVEMBER 4

Scientists carve nanowires out of ultrananocrystalline diamond thin films

A team of scientists working at Argonne National Laboratory's (ANL) Center for Nanoscale Materials has successfully carved ultrananocrystalline diamond (UNCD) thin films into nanowires – boosting the material's functionality to the next level. UNCD thin films are a special form of diamond invented at ANL, and the subject of tremendous interest because of the material's highly desirable ability to alter its electrical properties when the chemical bonding between grain boundaries is modified. "It's a highly attractive carbon-based material with a wide range of applications in communications, medicine, and defense," notes Anirudha Sumant, a materials scientist at ANL. A primary motive behind their studies, he explains, is to understand the electrical transport properties of UNCD when it's fabricated into a nanowire geometry. They also want to see how these properties can be altered by changing chemical bonding at the grain boundary and by taking advantage of increased surface-to-volume ratio at the same time. "We've demonstrated a pathway to fabricate UNCD nanowires, with widths as small as 30 nanometers at a thickness of 40nanometers, by using a top-down fabrication approach that combines electron beam lithography and reactive ion etching process," says Sumant. They also discovered that among the exceptional electrical properties of the UNCD nanowires, it demonstrates a resistance that is extremely sensitive to the adsorption of gas molecules at the grain boundaries. The discovery opens up new possibilities for the fabrication of advanced nanoscale sensors, according to the team.

Presentation MN-FrM6 "Fabrication and Characterization of Structural and Electrical Properties of Ultrananocrystalline Diamond Nanowires" is at 10 a.m. on Friday, Nov. 4.

MORE INFORMATION ABOUT THE AVS 58th INTERNATIONAL SYMPOSIUM & EXHIBITION

The Nashville Convention Center is located eight miles away from the Nashville International Airport at 601 Commerce St., Nashville, Tennessee, 37203.

USEFUL LINKS:

Main meeting website:
http://www2.avs.org/symposium/AVS58/pages/greetings.html [1]
Technical Program: http://www2.avs.org/symposium [2]
Housing and Travel Information:
http://www2.avs.org/symposium/AVS58/pages/housing_travel.html [3]

PRESS REGISTRATION

The AVS Pressroom will be located in the Nashville Convention Center. Your complimentary media badge will allow you to utilize the pressroom to write, interview, collect new product releases, review material, or just relax. The media badge will admit you, free of charge, into the exhibit area, lectures, and technical sessions, as well as the Welcome Mixer on Monday evening and the Awards Ceremony and Reception on Wednesday night. Pressroom hours are Monday-

Thursday, 8-5 p.m.

To register, please complete the media registration form (available online at http://www.avs.org/pdf/pressinvite.pdf [4]) and fax or e-mail by October 15 to:

Della Miller, AVS
Fax: 530-896-0487
E-mail: della@avs.org [5]

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