Science and Technology
of Materials, Interfaces, and Processing

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Biotechnology and New Medical Materials Highlight AVS 56th International Symposium & Exhibition, San Jose, CA, Nov. 8-13, 2009

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FOR IMMEDIATE RELEASE

For more information contact
Jason Socrates Bardi,
American Institute of Physics
301-209-3091 office
858-775-4080 cell
jbardi@aip.org

Della Miller, AVS
530-896-0477
della@avs.org

November 4, 2009 -- Many of the medical tools of tomorrow are under development today thanks to scientific discoveries in nanotechnology and materials research. As highlighted below, some of the latest advances in these fields will be described next week at the AVS 56th International Symposium & Exhibition in San Jose, CA.

The symposium takes place November 8-13, 2009 at the San Jose Convention Center. Overall the meeting showcases advances in nanotechnology, alternative energy, materials research, and medicine -- from fuel cells and batteries of the future to programmable materials and innovative approaches to drug design.

Reporters are invited to attend the conference free of charge. Registration information can be found at the end of this release.

BIOTECHNOLOGY HIGHLIGHTS OF 56th AVS MEETING

1) STERILIZATION: Plasma-in-a-Bag for Sterilizing Devices
2) DRUG DELIVERY: Enhancing Oral Availability
3) DENTAL FILLINGS: Look Ma, No Mercury!
4) CANCER THERAPIES: Nanoparticles Surf the Bloodstream
5) ANTIMICROBIALS: Silver (And Copper) Bullets to Kill Bacteria
6) MEDICAL IMPLANTS: Keeping them Cleaner (Not Yet Approved)

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1) PLASMA-IN-A-BAG FOR STERILIZING DEVICES The practice of sterilizing medical tools and devices helped revolutionize healthcare in the 19th century because it dramatically reduced infections associated with surgery. Through the years, numerous ways of sterilization techniques have been developed, but the old mainstay remains a 130-year-old device called an autoclave, which is something like a pressure steamer. The advantage of the autoclave is that the unsterile tools can be packed into sealed containers and then processed, staying sealed and sterile after they are removed.

Norbert Koster and his colleagues at TNO Science and Industry, an independent research organization in the Netherlands, are developing a new way to sterilize medical devices by sealing them inside plastic bags and then using electromagnetic fields to create plasmas -- partially ionized gasses that contain free electrons and reactive ions. Scientists have known for a long time that plasmas have the ability to kill bacteria and sterilize objects, but the major problem has always been that plasma-sterilized objects still had to be packed into a sealed container afterwards. There was no way to sterilize them inside sealed containers.

Now Koster and his colleagues have developed a way to do just that. They found a way to sterilize medical tools by sealing them inside vacuum bags and then placing them in chambers that are at even lower pressure. This causes the vacuum pack around the tools to puff out. Then they use an electromagnetic field to remotely ignite a plasma inside the bag, killing the bacteria and viruses therein. When the process is finished and the bag is removed from the chamber, the outside pressure causes it to shrink down again to closely wrap the now sterilized objects, keeping them sealed.

At the moment, Koster and his colleagues are investigating how long the discharge needs to be to destroy all the bacteria and viruses. This technique is not likely to replace the traditional autoclave any time soon, but it opens up the possibility of sterilizing new types of instruments, including devices like detectors and other fancy electronics that would otherwise be damaged by traditional steam-and-heat methods.

The talk "A Novel Way of using Plasma to Sterilize Objects for Use in Medical, Food or Pharmaceutical Applications" is at 9:40 a.m. on Friday, November 13, 2009. Abstract: http://www.avssymposium.org/Open/SearchPapers.aspx?PaperNumber=PS-FrM-5

2) ENHANCING DRUG DELIVERY

Of the many characteristic traits a drug can have, one of the most desirable is the ability for a drug to be swallowed and absorbed into the bloodstream through the gut. Some drugs, like over-the-counter aspirin, lend themselves to this mode of delivery and are trivial to take. They can be pressed into a pill and swallowed. Other drugs cannot be swallowed and must be administered instead through more complicated routes. Insulin, for instance, must be injected.

The reason why insulin and many other drugs cannot be swallowed is that they cannot survive the trip through the digestive tract -- wherein they are first plunged into the acid bath of the stomach and then passed into the intestines, which are filled with enzymes designed to break down molecules like insulin. Aspirin does fine in the gut because its active ingredient is a small chemical that doesn't get broken down. But insulin is quickly degraded.

Tejal A. Desai (University of California, San Francisco) is looking at ways to enhance the "oral availability" of drugs by designing new delivery devices that will help their absorption in the gut. Working with a Bay-area biotechnology company, she is making devices that are sort of like spiny beads filled with drugs. The spines on these beads are silicon nanowires designed to form an adhesive interface with the tiny, hair-like cilia that cover the cells lining the gut. They are designed to stick like burrs to the cells lining the gut and slowly release their drugs there. Localized in one spot, the drugs have a better chance of diffusing into the bloodstream.

Desai is currently fine-tuning the geometry of the nanowires in order to optimize their adhesion. Her laboratory has done a number of toxicity studies with the beads, and their plan next is to look at how effectively they can deliver proteins, peptides, and other macromolecules that are not usually taken orally.

One of the advantages of this approach, Desai says, is that it may be applicable for delivering drugs to other part of the body as well, such as mucosal tissues like the insides of the nose, lungs, or vagina, where the surface cells are also coated with such cilia.

The talk "Micro and Nanostructured Interfaces for Therapeutic Delivery" is at 11:20 a.m. on Thursday, November 12, 2009. Abstract:
http://www.avssymposium.org/Open/SearchPapers.aspx?PaperNumber=TF-ThM-11

3) LOOK MA, NO MERCURY!

Tooth enamel is hardest material in the human body because it's made almost entirely of minerals. As tough as it may be, however, enamel can be broken down by bacteria, forming cavities and eventually destroying the tooth. That's why dentists repair cavities by filling them with a material to replace the lost enamel. The most common such restorative is a material invented in the 19th-century known as amalgam -- the classic silver-black fillings many people have.

Amalgam works well because it is very durable, easy to use, and cheap. The dark fillings are sometimes unsightly, however, and they contain mercury. Because of the mercury, amalgam has raised health and environmental questions -- though according to the American Dental Association, the scientific consensus is that the material poses no health hazards. Dentists would love to have a perfectly white material that mimics natural enamel for repairing cavities in teeth, but for the most part, they still use amalgam. Other filling materials have been developed in recent years, but they often have problems with shrinkage or durability.

Kent Coulter and his colleagues at Southwest Research Institute in San Antonio have developed a new proof-of-concept dental restorative material under a program funded by the National Institutes of Health that seeks to replace amalgam with other materials. The new fillings are made with a plastic-like material containing zirconia nanoplatelets -- tiny crystals made of the same sort of material used to make fake diamonds and gem stones. Unlike their costume jewelry cousins, the zirconia nanoplatelets super hard because of a difference in the particular arrangements of the atoms in the material.

Coulter and his colleagues designed a way to make a roll of this material under vacuum. They envision that this material would be lifted from the roll and packed in a dental cavity and then cured -- using an ultraviolet lamp or some other means -- so that it hardens in place without shrinking. In San Jose, they will describe how they have been developing and testing the performance of these materials in the laboratory. Its use is still several years away from the dentist's chair, however, and the next steps will be first to see if the new material performs as hoped for people with cavities.

The talk " Zirconia Nanoplatelets for use in Dental Restoratives" is at 8:20 a.m. on Monday, November 9, 2009. Abstract:
http://www.avssymposium.org/Open/SearchPapers.aspx?PaperNumber=NS+BI-MoM-1

4) IDEAL NANOPARTICLE CANCER THERAPIES SURF THE BLOODSTREAM Eric Shaqfeh studies blood at Stanford University, using computer models that simulate how the fluid and the cells it contains move around. At this year's AVS meeting, he will present his latest unpublished findings from two studies. One shows how components in blood line up to prepare for healing; the other demonstrates the best shape to use for manmade nanoparticles that target cancers -- a surfboard.

The different components that move through our blood stream are not evenly distributed. For years, scientists have known that platelets -- which help blood to clot -- stay close to the walls of blood vessels as they circulate.

"When somebody cuts himself, the fact that the platelets are sitting seven times more frequently at the edges of the little blood vessels is critical," says Shaqfeh.

His models suggest that when a new platelet is made, it takes longer than expected to migrate to and line up at the edge -- as much as ten or fifteen minutes to establish "hemostatis," in which blood cells are properly distributed in the body. The research, funded by the Army, suggests that current techniques for blood transfusions may not be ideal. Freezing platelets, which is common practice, may change their shape and disrupt their movements, and there may be better ways to give transfusions that establish the proper blood arrangement faster, says Shaqfeh.

In related work, Shaqfeh added tiny nanoparticles of various sizes and shapes into his blood models. Such particles are of interest to the cancer researchers, who hope to use nanoparticles to target the walls of blood vessels that feed tumors. Shaqfeh found that surfboard-shaped particles stayed closest to the walls of blood vessels. He will soon be working with another group to test fluorescent surfboard-shaped particles in actual blood vessels to see how they behave.

The talk "The Microfluidics of NonSpherical Colloidal Particles and Vesicles with Application to Blood Additives" is at 11:20 a.m. on Wednesday, November 11, 2009. Abstract: http://www.avssymposium.org/Open/SearchPapers.aspx?PaperNumber=IJ+BI+MN-WeM-11

5) SILVER (AND COPPER) BULLETS TO KILL BACTERIA Dana Filoti of the University of New Hampshire will present thin films of silver and copper she has developed that can kill bacteria and may one day help to cut down on hospital infections. The antimicrobial properties of silver and copper have been known for centuries -- last year, the U.S. Environmental Protection Agency officially registered copper alloys, allowing them to be marketed with the label "kills 99.9% of bacteria within two hours." Copper ions are known to penetrate bacteria and disrupt molecular pathways important for their survival.

Using zeolite ceramic structures, Filoti is testing the hypothesis that the combination of silver and copper might work synergistically to better kill bacteria. "The hard ceramic structure looks like Swiss cheese and inside the holes there are ions of silver and copper," says Filoti.

By experimenting with the ratio of the two metals and the texture of the thin films, she has been able to reduce the amount of microbes present on the surface by 99 percent. One application of these antimicrobials, which Filoti is developing in partnership with a company in New Hampshire, is an antimicrobial face mask designed to protect against pathogens that cause many hospital-acquired infections.

The talk "Synergistic Ag (111) and Cu (111) Texture Evolution in Phase Segregated Cu1-xAgx Magnetron Sputtered Composite Thin Films" is at 10:40 a.m. on Thursday, November 12, 2009. Abstract:
http://www.avssymposium.org/Open/SearchPapers.aspx?PaperNumber=TF-ThM-9

6) KEEPING MEDICAL IMPLANTS INFECTION FREE One of the best measures of the importance of medical implants is their ubiquity. Millions of implants -- from devices as simple as stents and catheters to instruments as advanced as artificial pacemakers -- are implanted in people in the United States every year, allowing many of them to live longer and enjoy greater health.

Many implant stories have tragic endings, however, because they are often associated with secondary infections. The fouling of implantable materials with bacteria or other pathogens is, in fact, the number one cause of hospital-acquired infections, which is itself the fourth leading cause of death in the United States. Such infections strike millions of people each year and burden our health care system with billions of dollars of additional costs.

In San Jose, James Bryers of the University of Washington will present some of the latest approaches his group and other laboratories are taking to modify implantable materials to prevent infections. One of the major strategies, already used in modern heart stents, is to coat the devices with antibiotics or other drugs that kill bacteria, reduce their virulence, or interfere with their ability to form colonies.

Another approach, which Bryers refers to as "engineering infection Immunity," involves loading the implants with either DNA or RNA vaccines vectors that induce an immune response to the bacteria. The interesting thing about this approach, says Bryers, is that the implants themelves help the immune reaction along. He has data from his own research that shows how vaccine loaded onto a solid device induces an immune response that is several orders of magnitude stronger than an injection of vaccine alone.

The talk "Emerging Strategies to Prevent Bacterial Colonization of Medical Biomaterials" is at 2:40 p.m. on Tuesday, November 10, 2009. Abstract:
http://www.avssymposium.org/Open/SearchPapers.aspx?PaperNumber=BI-TuA-3

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INFORMATION FOR JOURNALISTS

The AVS 56th International Symposium & Exhibition lasts from November 8-13, 2009 in San Jose, CA. All meeting information, including directions to the San Jose Convention Center is at: http://www2.avs.org/symposium/

Staff reporters and freelance journalists working on assignment for major media outlets are invited to attend the conference free of charge. Journalist registration instructions can be found at: http://www.avs.org/pdf/pressinvite.pdf

USEFUL LINKS
Online press room: http://www.avs.org/inside.press.aspx
Searchable abstracts: http://www.avssymposium.org/Open/SearchPapers.aspx
Full meeting program: http://www.avssymposium.org/Overview.aspx
Main meeting page: http://www2.avs.org/symposium/AVS56/pages/info.html

ONSITE MEETING PRESS ROOM
The AVS press room will be located in Concourse 1 of the San Jose Convention Center. Press room hours are Monday-Thursday, 8:00-5:00 pm. The phone number there is 408-271-6100. Press Kits containing company product announcements and other news will be available on CD-ROM in the press room.

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ABOUT AVS
As a professional membership organization, AVS fosters networking within the materials, processing, and interfaces community at various local, national or international meetings and exhibits throughout the year. AVS publishes four journals, honors and recognizes members through its prestigious awards program, offers training and other technical resources, as well as career services.