August 2011 Issue

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AVS 58
Oct. 30-Nov. 4, 2011
Nashville, TN

Website

AVS 58 Highlights

Redefining Clean

AVS 58: Monday, October 31, 5:00 p.m.
When it comes to surgical procedures, using sterile equipment is ideal. Yet disinfecting medical instruments is not easy. In fact, conventional sterilization methods can leave behind some harmful bacterial residues that are partially resistant to elevated temperatures.

Aiming to take "clean" to a whole new level, researchers at the University of California at Berkeley and the University of Maryland at College Park teamed up to study how low-temperature plasmas can "deactivate" potentially dangerous biomolecules that bacterial residues form. Using low-temperature plasmas is a promising technique for sterilization and deactivation of surgical instruments and medical devices, but the researchers say its effectiveness isn't fully understood yet.

"Bacteria are known to create virulence factors-biomolecules expressed and secreted by pathogens-even if they have been killed, such as lipopolysaccharide (LPS) in the membranes of E. coli bacteria," explains David Graves, a professor working on the research at UC Berkeley's Department of Chemical and Biomolecular Engineering.

The presence of LPS in host tissue or circulating in the blood is a serious problem--it can lead to a generalized sepsis syndrome, including fever, hypotension, and respiratory dysfunction, or even cause multiple organ failure and death.

Another well-known example of virulence factors, Graves points out, are the misfolded proteins called "prions" that are thought to cause mad cow disease. "These molecules aren't inactivated by conventional autoclaves or other methods of disinfection or sterilization," he says. "In some cases, expensive endoscopes used in the brain must be discarded after a single use because the only way to reliably decontaminate them would destroy them."

For their research, the team is using a vacuum-beam system to study Lipid A as a model biomolecule, because it's the major immune-stimulating region of LPS. Lipid A has toxic properties and is known to stimulate an intense host immune response that can cause generalized sepsis syndrome.

"Low-temperature plasma generates vacuum ultraviolet photons, ions/electrons, and radicals that are known to be able to deactivate these molecules even at low temperature," notes Graves. "However, the mechanisms by which they do this is poorly understood, so we can't be sure when they work and when they don't. Our measurements and calculations are designed to reveal this information."

The team's results suggest that plasma-generated vacuum ultraviolet (VUV) 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.