Researchers build a new surface material that resists biofilm growth

March 19 2009

This is the tale of two biological substances—cells from mammals and bacteria. It's a story about the havoc these microscopic entities can wreak on all manner of surfaces, from mighty ships to teeth and medical devices, and how two Syracuse University researchers are discovering new ways prevent the damage.

Under moist conditions, bacteria form what scientists call biofilms—a sticky, slimy buildup on almost any kind of surface. Biofilms can corrode the hulls of ships, produce green slime on rocks, pollute drinking water systems, form plaque on teeth, and stick to medical devices implanted in humans, resulting in infection or rejection.

It's critically important, therefore, for scientists to gain a better understanding of how biofilms are formed and use that knowledge to develop surfaces that will resist such biofouling. In an unusual, interdisciplinary collaboration, SU researchers have found that if you can prevent protein from sticking to a surface, you can prevent both bacteria and mammalian cells from doing likewise. In the process, they developed a novel, surface technology that scientists can use to study biofilms in ways that were not previously possible.

In a series of experiments, Yan-Yeung Luk, assistant professor of chemistry in SU's College of Arts and Sciences; and Dacheng Ren, assistant professor of biomedical engineering in the L.C. Smith College of Engineering and Computer Science, created a surface material on which they could manipulate and confine biofilm growth four times longer than current technologies. By further manipulating the chemical makeup of the surface, the scientists uncovered how mammalian cells and bacteria adhere to surfaces.

Their work, which is supported by grants from the National Science Foundation, was recently reported in the February 4 online version of "*ChemComm*," the journal of the Royal Society of Chemistry (forthcoming in print); and in the January 9 online version of "Langmuir," published by the American Chemical Society (forthcoming in print).

Luk and Ren began collaborating about three years ago when they discovered a common thread in their individual research efforts—the desire to chemically modify surfaces to prevent biofouling. They went on to create a surface that seems to repel both bacteria and mammalian cells when the molecule is chemically applied to a surface. The surface used in the laboratory is a thin film of gold coated on a glass slide.

They explain their research in terms of land, soil, and plants. "You start with a glass surface (the land); apply a thin film of gold to that surface, about 20 nanometers or five atoms thick (the soil); then top the gold with the molecules we created in the laboratory (the trees)," Luk says. "The goal is to see if the special molecules (trees) can resist or prevent protein from sticking to the overall surface. Put another way, do the trees provide an inhospitable environment for birds (the biofilm) and therefore prevent them from roosting en mass?"

The surface the researchers created in the laboratory was able to confine the growth of bacteria to surface patterns of desired, two-dimensional shapes. In other words, the researchers were able to control the growth of the biofilm with the surface material, allowing the biofilm to form in some places and restricting its growth in others. Additionally, the scientists found that when confined in two dimensions, the biofilm grew in a vertical direction.

In other experiments, the scientists discovered important differences in the way mammalian cells and bacteria attach to a surface. "Our surfaces are able to reveal that mammalian cell adhesion requires the existence of an anchor, while bacteria can adhere to almost any sticky surface," Luk says.

The researchers' discoveries and the surface technology they developed can be used to answer critical questions that previously eluded scientists and lead to the development of improved medical implants and to new ways to prevent biofouling.

"This level of surface control has never before been achieved," Ren says. "We hope that what we have learned in the laboratory will help answer other fundamental questions in surface materials research and lead to the production of new materials for use in medicine and industry."

Source: Syracuse University

Citation: Researchers build a new surface material that resists biofilm growth (2009, March 19) retrieved 26 April 2024 from
https://phys.org/news/2009-03-surface-material-resists-biofilm-growth.html