Professors Team Up To Make Implanted Devices 'Sticky'

Eric Swedlund, University of Arizona

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Jeong-Yeol Yoon [1], associate professor of agricultural and biosystems engineering, and Dr. Marvin Slepian [2], professor of cardiology and biomedical engineering, collaborated to test how nanotechnology-based techniques can be used to better facilitate adhesion between tissue and implanted devices.

“When we created the nanotexture surface, we thought it could be used as a sticky surface for the implants,” Yoon says.

Cell-substrate adhesion involves the interplay of mechanical properties, surface topographic features, electrostatic charge and biochemical mechanisms. By working at the nanoscale level, Yoon was able to maximize the physical properties of the underlying substrate in promoting adhesion.

But beyond simply creating a sticky surface, the researchers' goal was to create a selectively sticky surface, favoring endothelial cell attachment, without favoring platelet attachment, Slepian says.

The connection between Yoon, a specialist in biosensors and nanotechnology from the College of Agriculture and Life Sciences [3], and Slepian, co-founder and chief scientific officer of artificial-heart manufacturer SynCardia, came about by chance. A graduate student in Yoon’s lab met Slepian through their shared interest in bicycling.

“It’s very rare for the agriculture people to work with the cardiovascular people in the medical school,” Yoon says.

But their research specialties clicked.

One particular challenge to overcome in cardiovascular implants is the potential for devices – such as stents placed inside coronary arteries – to become detached as a result of blood flow, Yoon says.

“We’re particularly focused on the cardiovascular applications because there’s a blood flow involved and our system is very good when there’s a flow situation,”

Yoon says.

The results of the study, published in the journal Advanced Healthcare Materials [4], reveal that the researchers' strategy leads to enhanced endothelial cell adhesion under both static and flow conditions.

The adhesive properties derive from optimized surface texturing, electrostatic charge and cell adhesive ligands (molecular binding substances) that are uniquely assembled on the substrata surface as an ensemble of nanoparticles trapped in nanowells.

"There are lot of other people out there who use nanotechnology for improving the implants, but this is stronger than other adhesive methods using nanotechnology," Yoon says.

"Obviously it can be used for everything else – lungs, digestive track and other systems. There are lots of other opportunities we haven't explored," he says.

The research is a perfect fit for Advanced Healthcare Materials, a new journal that spun off from the longstanding Advanced Materials journal.

"The use of the materials for the health care applications is probably the hottest area in materials science and engineering," Yoon says. "We believe the journal will become even stronger than the mother journal."

Just as the new journal marks an exciting intersection of disciplines, Yoon says the environment at the UA encourages such interdisciplinary approaches.

"I joined the University of Arizona because there are so many interdisciplinary activities going on. I see a lot of collaboration between departments in the same college at other universities, but at the University of Arizona, the environment is more open and you see collaboration across colleges," Yoon says.

Slepian agreed, saying the pair has already filed grant applications for future work together.

"It has been fun and exciting to have an interdisciplinary collaborator," he says.

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