Nano-interfaces with cells

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Coatings made with titanium and peppered with pores only nanometers or billionths of a meter wide could help interface living cells with electronics for prosthetics and other advanced devices, experts told UPI's Nano World.

Scientists worldwide are developing microelectromechanical devices that can interface with biological systems. These include miniature robots that move with the aid of rat heart muscle cells and prostheses that link with nerves, explained Abu Samah Zuruzi, a materials engineer at Intel Assembly Technology Development in Chandler, Ariz.

These devices are often created with tools developed from the microchip industry and therefore are usually made with silicon-based compounds such as silicon dioxide or silicon nitride.

"I found that cells take a relatively long time to adhere to these surfaces," Zuruzi said. On the other hand, he and his colleagues found that past research into medical implant design suggested that cells stick to and grow better on surfaces made of biocompatible materials such as metal oxides and which possess nanometer-scale features such as bumps or pores. The most accepted explanation for this enhanced growth is that proteins on cell surfaces attach faster onto nanostructured materials because of their increased surface area, Zuruzi said.

Zuruzi and colleagues at the University of California at Santa Barbara developed a method to create spongy films of titanium dioxide anywhere from 25 to 750 nanometers thick laced with pores 50 to 200 nanometers wide. They found the rate at which cells attached to these surfaces was as much as four to five times faster than with conventional silicon dioxide or silicon nitride surfaces. Zuruzi and his colleagues will present their findings in the Jan. 28 issue of the journal Nanotechnology.

Increasing the speed at which cells stick to devices could greatly speed up medical diagnostics. "What I'd like to see is rather than waiting two or three days to get the results, you could get it on the order of half and hour," Zuruzi said.

Their method "uses starting materials and equipment that are already commonly used in the microelectronics industry. Hence, it is relatively easy to implement," Zuruzi added.

"What is most exciting about this work is its simplicity," said Andrei Kolmakov, a physicist at Southern Illinois University in Carbondale, who did not participate in this study. "Just rinse titanium film in hydrogen peroxide at 80 degrees C, dry it and you are done. Can't be easier."

Ongoing research into novel interfaces will incorporate molecules known to promote cell growth, Zuruzi said. Future research could also examine nanostructured surfaces made of other metal oxides, such as zinc oxide or tin oxide. However, past research suggests enhancing cell attachment and growth is less a matter of which biocompatible material is used and more a matter of how nanostructured the surface is. "If you want to fabricate nanostructured silicon dioxide or silicon nitride, it's somewhat difficult," Zuruzi said. "The method we use is totally compatible with processes already used in the industry. No additional tools are necessary."

The easy-to-make nanostructured titanium dioxide films the researchers developed could also find use in other applications. For instance, the high surface-to-volume ratio of the nanostructured titanium dioxide "means that it is a good sensing material," he said.