Need to filter water? Fight infection? Just open package, mix polymers

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(Phys.org)—Working in the lab for the last few years, three generations of University of Akron polymer scientists say their mutual and passionate curiosity about science has led to their discovery of a first-of-its-kind, easily adaptable biocompatible polymer structure able to fight infection, filter water and perform a host of other functions.

Darrell Reneker, 82, distinguished professor of polymer science; Matthew Becker, 37, associate professor of polymer science; and Jukuan Zheng, a 25-year-old graduate student, developed what they call a one-size-fits-all polymer system that can be fabricated and then specialized to perform healing functions ranging from fighting infection to wound healing. The research, "Post-Assembly Derivatization of Electrospun Nanofibers via Strain-Promoted Azide Alkyne Cycloaddition," is published in the Journal of the American Chemical Society.

Material can be adapted to the need

The researchers devised a way to attach bioactive molecules to an electrospun polymer fiber mat, without compromising their biological functions. The possibilities for application should pique interest among developers and clinicians, say the scientists. Consider, for instance, Teflon-based vascular grafts used for aneurysm surgery since WWII being replaced by a strong, durable polymer structure with surface proteins that function as healthy blood vessels.

"We can design a blood vessel that can be put in different places and coated with different materials—specific for the heart, specific for vascular, specific for the brain," Becker says.

Through the development, scientists for the first time place small molecules such as peptides, proteins, drugs and carbohydrates, which normally influence how cells behave, and attach therapeutic concentrations of chosen bioactive substances to the surfaces of an implant, after it has been fabricated. The bioactive efficacy and biocompatibility of the base surface then enables it to be implanted into the human body and perform healing functions that can save lives.

Process efficient and effective

"There have been many types of polymers used in biomaterials, but the challenge with that has been, every time you make a new product it requires a new process," Becker explains. "This chemistry will be very useful in that you can manufacture many different implant products that contain the same kind of sites for attachment and put any of a wide variety of bioactive substances on the same kind of attachment site."

An unlimited number of biologic molecule types can be attached to the surface of a fibrous system, from antibiotics to fracture-healing vitamins.

"Imagine an emergency combat medic carrying around a box of bulky bandages to provide exactly the needed function from a larger number of possible needs," Reneker says. "This system provides choice without bulk."

Jukuan adds that he envisions the multifunctional development transitioning into an easy-to-use formula.

"This material will make life easier," he says. "People will just open a package, mix two ingredients and it will be ready to use."

More information: pubs.acs.org/doi/abs/10.1021/ja307647x

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