Researching Materials on a Nanoscale Level

Not everyone spends their day looking at how a material's macromolecular components behave at the scale of one one-thousandth the width of a human hair. Dr. Thomas H. Epps III is the Thomas and Kipp Gutshall Professor of Chemical and Biomolecular Engineering at the University of Delaware. By diving into that nanoscale level, Epps and his research group use polymer physics to understand how materials are structured, which can have meaningful effects on designing materials that can help people. Epps is Sigma Xi's 2014 Young Investigator Award winner and will speak at the Society's Annual Meeting in November.

What would you say it is about polymer physics that interests you?
One of the things that interests me is the ability to help improve society. One of the ways we accomplish that in polymer physics is understanding the behavior of polymer systems for applications ranging from drug delivery to membranes, whether that is for separations or energy storage and energy generation, catalysis to produce greener systems, or even composite materials such as those you find on next generation aircraft. What really interests me in all of those [areas] is really probing down, in our case, to looking at the nanoscale level, and trying to understand how macromolecules actually arrange on that nanometer scale, and how that ultimately results in the macro scale properties that you see: flexibility, elastic nature, ability to deform, and recover.

What is an example of how people would interact with polymer physics?
Many of the clothes you wear that are, for example, polyesters or nylons—those are polymeric materials, and we can design materials that either fit better or are lighter weight. Other examples are things like car tires, which are made of rubber and are composite materials. Really understanding how a polymer works allows us to design better tires for more fuel-efficient cars but also allows us to maintain properties like the traction and stability that are necessary from a safety standpoint.

What are some of the bigger challenges that your field is helping address for society?
When we look at materials for batteries, fuel cells, or even solar cell devices, one of the key aspects is really understanding how we can improve the transport and efficiency of these materials, and much of that boils down to understanding [and controlling] the nanoscale organization.

Where do you think the field is going to be in the next 50 or 100 years?
I think one of the things that has been particularly unique about the field, and where it has an opportunity to grow, is linking designer chemistry to nanoscale or materials development in terms of manipulating the physics of macromolecular materials. Additionally, the ability to link experimental methods with theory and modeling development is starting to take leaps and bounds forward and will continue to do so.

You've been active in supporting underrepresented minorities in science and engineering. What do you think will bring more underrepresented minorities to these fields?
In polymer physics, for example, the opportunity is showing how polymer physics can have an impact on daily life by exposing students and the community to the opportunities in research—in science and engineering—and in my case, in polymer physics. Showing [people] that you can do it, too—providing the mentorship and the support to allow people to accomplish their scientific goals.

I think one key aspect is to actually think about how to reach students at an earlier age such that they can prepare through their schooling to be ready [for a career] like, in my case, chemical engineering or polymer physics, or whatever avenues they choose to pursue.

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