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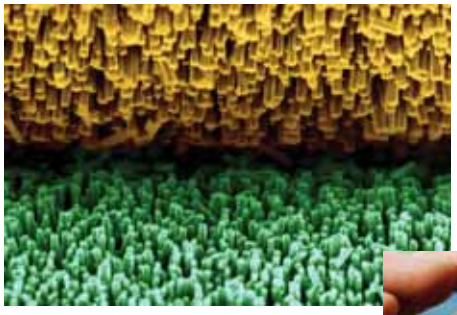
Cloth Fibers that Generate Electricity

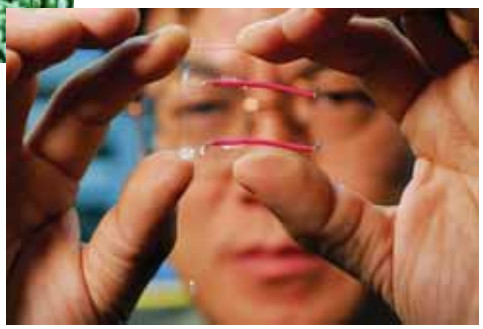
In the next edition of our textbook *Introduction to Technology*, Dennis Karwatka and I define nanotechnology as the "science of working with the atoms and molecules of materials to develop very small machines." To build these nanotech-size machines, scientists often draw on the knowledge of mechanical and electrical engineers, chemists, physicists, mathematicians, and experts in robotics. Nanotechnology projects often also involve other life science experts who manipulate atoms, molecules, and chromosomes. They change the very nature of certain bugs and turn them into useful factories that produce materials to benefit humankind.

Try to imagine a machine that is so tiny, about 100 nanometers in size, that you need a very powerful microscope just to see it and its even smaller parts. To grasp the size, look at a single strand of your hair—it's approximately a hundred thousand nanometers thick.



Georgia Tech image courtesy of Zhong Lin Wang and Xudong Wang

Photo 1—Microscopic image of a paired fiber



Georgia Tech image by Gary Meek

Photo 2—Professor Zhong Lin Wang holding a prototype of the microfiber nanogenerator

A new nanotech machine has recently been announced by the Georgia Institute of Technology. It was created by a research group at the university under the direction of Professor Zhong Lin Wang. The group developed paired nano textile fibers that convert physical movement into electricity. The individual fibers are microscopic in size. (See Photo 1.) But when you weave enough of them together you create a microfiber nanogenerator that looks like thick threads. (See Photo 2.)

If this new technology stays on track, you will eventually be able to purchase clothing that generates electricity by converting your physical movement into an electric current. Georgia Tech's microfiber nanogenerator is designed to be woven into any fabric. Imagine flags flapping in the wind, creating an environmentally clean inexpensive electricity. Perhaps windmill farms will one day have a competing technology that generates energy by harvesting the wind.

The Georgia Tech team created their fibers by growing zinc oxide nanowires on DuPont Kevlar fibers. Their paired fibers create piezoelectricity, electricity produced by stressing or applying pressure to certain types of materials. To tap the generated electricity, each pair of fibers has a microscopic electrode that draws off the electricity that the fiber pairs generate.

The illustration that Georgia Tech supplied can help you understand how these fibers generate electricity. (See Fig. 1.) The microscopic paired fibers are shown as yellow and green intertwined brushes. In some ways this graphic almost looks like a major magnification of the microscopic fibers that appear in Photo 1. The bristles here represent the billions of microscopic bristles found on the real fibers. These bristles are entwined so they touch each other when any motion is applied. This mechanical motion generates electricity.

Polymer coatings protect the microscopic fibers and their bristles. The goal now is to create a strong-

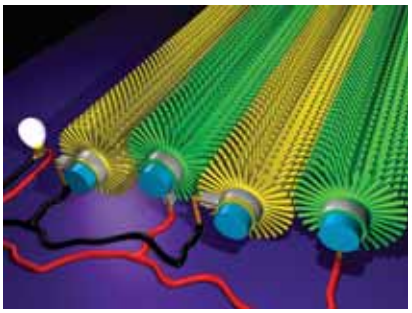


Photo credit Georgia Tech

Fig. 1—Graphic visualization of how a pair of fibers generate electricity

enough coating so fabrics that contain these fibers can stand up to repeated machine washing as well as the bending, twisting, and rubbing that causes them to generate electricity.

The Georgia Tech fabrication process currently produces batches of fibers that are about 3.5 microns long with a couple of hundred nanometer separation between each fiber. How small is a micron? A single strand of your hair is about 60 microns thick.

Can you imagine wearing a power suit of clothing that constantly charges your personal electronic gadgets?

Recalling the Facts

1. Fabric is often used as a wall covering. Could microfiber nanogenerator threads be sewn into these fabrics to generate electricity? Why?

2. If your clothing generates electricity, do you think you will need to take special care not to receive electric shocks? Why?

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.

