



Smartly Dressed

American research is transforming textile manufacturing, and may yet save this moribund industry.

By Steve Frumkin

THE DECLINE OF THE U.S. TEXTILE and garment industries is all too apparent. As recently as 1980, the apparel industry accounted for nearly 10 percent of all U.S. manufacturing jobs and employed more than 1 million workers; it now employs about one-third that number.

While the low-tech segment of the industry has been left for dead, the United States is not finished with textiles—at least not with fabrics that give the wearer something extra. While few manufacturers can justify making an ordinary shirt in this country, this humble industry leaves a great deal of upside for technological innovators.

Low-cost-labor centers in emerging markets are not in a position—yet—to invest in the research and development required to produce the materials for a shirt that “never wears out” nor one that monitors blood pressure. Nor will those countries that depend on high-volume production be willing to manufacture on the small scale necessary to try new technologies. But a number of U.S. companies are now making these intelligent textiles. These fabrics are embedded or treated with substances that have been broken down into tiny particles measured in nanometers: one-billionth of a meter, or the width of three to five atoms.

SMALL ADVANCES

Manufacturers are using nanotechnology to change the properties of these substances. As each particle becomes smaller, the ratio between surface area and volume is increased, bringing different atoms to the fore. This can fundamentally change a substance. The U.S. government, the biggest single backer of this research, invested \$1.6 billion in it last year. Private enterprises worldwide invested another \$2 billion. While fabric applications have seen a relatively small portion of this spending, they seem likely to capture a greater amount going forward. According to estimates based on data from the Department of Commerce and the U.S. Patent and Trademark Office, textile-related technology will become a \$450 million industry by 2006.

Nano-*Tex*, based in Greensboro, N.C., is one of the companies behind the nanotechnology making fabrics spill resistant, durable and breathable. Crypton Fabrics, in the same city, has

patented a fabric with an impervious membrane that resists stains, bacteria, odor and moisture; the health care industry is starting to use these textiles for sterile uniforms and bedding. The Army signed a \$50 million contract with MIT to develop nanotechnology applications for military clothing. The Department of Defense has also granted a research project to the School of Textiles and Materials Technology at Philadelphia University, where I teach, to develop fabrics that would make combat uniforms more protective.

Of course, the United States has an unfortunate history of developing leading-edge innovations, only to see them waylaid when companies in emerging markets master the technology; lower labor costs usually mean many jobs soon follow. In 2002, Levi Strauss, which no longer manufactures garments in the U.S., introduced a line of Dockers pants that incorporates Teflon as a guard against stains. The company also manufactures clothing that resists becoming damp from perspiration. Haggar Clothing, which makes almost all of its garments overseas, produces pants that appear to stay new, called the ForeverNew line. U.S. companies will continue to outsource production, and might eventually sell licensing rights to legitimate manufacturers overseas. But around the time China starts making nanotechnology-treated apparel, the United States will be developing applications for the next step in the industry: automated textiles that can sense outside stimuli and respond to it. So-called smart garments incorporate sensors that use nanotechnology or microelectronics.

Textiles that can change color and become warm or cool have already appeared on the market, as have jackets with voice-activated computer systems and athletic shoes that react to a runner's gait. Georgia Tech, MIT and other institutions have produced clothing that can keep track of soldiers in battle or patients with unstable conditions.

These garments are not readily available at the local mall, but that will change in the coming decade. As with most technological advances, there will be an awkward imbalance between high cost and low demand, but gradually the two will align with each other. If our clothes could talk—someday they will—this is what they would tell us. ■

Steve Frumkin is a professor at the School of Textiles and Materials Technology at Philadelphia University.

