Nano technology

ground floor opportunity for hosiery and textile manufacturers

by BRENT CHILDERS, *Editor*

Think of a sock about the size of a pinky toe that could stretch to fit a size 10 foot and retain its style, warmth and comfort qualities.

Now imagine a good size kitchen table. That would be the space needed to house the 30 knitting machines needed to produce a couple thousand of those socks per hour.

Imagine the savings in materials, electricity, packaging and so on.

Welcome to the world of nanotechnology.

Granted that there is some hyperbole involved in the above example and not to mention that the sales team may have fits figuring out a way to market a men's hunting sock the size of a pinky but it does address the fundamental concept of nanotechnology – small.

Very small.

Some of the brightest minds trained in molecular and chemical sciences are work to bring such technology out of the research realm and into the hands of manufacturers and of course ultimately the consumer.

They are closer than you think.

WHAT EXACTLY IS IT ?

Nanotechnology is an emerging technology that has been booming during the recent decade in areas such as materials science, mechanics, electronics, optics, medicine, plastics, energy, electronics and aerospace.

"Its profound societal impact has been considered as the huge momentum to usher in a second industrial revolution," write researchers Lei Qian and Juan Hinestroza, two N.C. State University researchers who published a paper last summer. In the article they give a brief introduction to nanotechnology.

The 'nano' in nanotechnology comes from the Greek word 'nanos' that means dwarf. Scientists use this prefix to indicate 10-9 or one-billionth. One nanometer is one billionth meter that is about 100,000 times smaller than the diameter of a single human hair. Nanotechnology endeavors are aimed at manipulating atoms, molecules and nanosize particles in a precise and controlled manner in order to build materials with a fundamentally new organization and novel properties. The embryo of nanotechnology is 'atomic assem-

bly', which was first publicly articulated in 1959 by physicist Richard Feynman. Nanotechnology is called a "bottom up" technology by which bulk materials can be built precisely in tiny building blocks, different from the traditional manufacture 'top down' technology. Therefore, resultant materials have fewer defects and higher quality. The fundamentals of nanotechnology lie in the fact that properties of substances dramatically change when their size is reduced to the nanometer range. When a bulk material is divided into small size particles with one or more dimension (length, width, or thickness) in the nanometer range or even smaller, the individual particles exhibit unexpected properties, different from those of the bulk material. It is known that atoms and molecules possess totally different behaviors than those of bulk materials; while the properties of the former are described by quantum mechanics, the properties of the latter are governed by classic mechanics. Between these two distinct domains, the nanometer range is a murky threshold for the transition of a material's behavior. For example, ceramics, which normally are brittle, can easily be made deformable when their grain size is reduced to the low nanometer range. A gold particle of 1 nm across shows red color. Moreover, a small amount of nanosize species can interfere with matrix polymer that is usually in the similar size range, bringing up the performance of resultant system to an unprecedented level.

In an interview, Hinestroza pointed out there is a distinction to be made between what is often referred to as nanotechnology as it is being applied today with the use of nanoparticles and what he referred to as "true nanotechnology" – the manipulation of atoms and molecules to produce new materials or new characteristics of existing materials.

There have been breakthroughs in the molecular tweaking of substances but one formidable challenge is creating machines, or robots, that are small enough to manipulate atoms and molecules.

Nanotechnology researchers like Hinestroza are at work trying to meet those challenges at N.C. State University and other research centers. The University of South Carolina is investing $40 million over three years for a NanoCenter on its campus.

The best guess is that engineering materials from the "bottom up" is still 10 years out. But that's only a guess. It could be sooner, maybe later, but generally scientists agree it will happen.

In the meantime, the nanotechnology research has already yielded real-life applications from employing nanoparticles and nanosubstances in the manufacturing sector.

WHAT CAN WE DO WITH IT?

The textile industry has already been impacted by nanotechnology. Research involving nanotechnology to improve performances or to create unprecedented functions of textile materials are flourishing. That research is mainly focused on using nanosize substances and generating nanostructures during manufacturing and finishing processes.

Fiber and yarn companies and chemical companies are already working to produce products that employ the use of nanoparticles in the manufacturing process. Hyosung last year announced that it had become Korea's first developer of nanotechnology fiber.

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The main feature of the Hyosung product, called Mipan Nano-Magic Silver, is the permanent and powerful antibiotic effect produced from the material "Nano silver." According to the announcement at the time, the product was 99.9 percent effective in preventing infection, including pneumobacilli, colon bacilli and fungi causing athletes foot, without causing harm to humans.

The impact of nanotechnology in the textile finishing area has brought up innovative finishes as well as new application techniques. Attention has been paid in making chemical finishing more controllable and more thorough. Ideally, discrete molecules or nanoparticles of finishes can be brought individually to designated sites on textile materials in a specific orientation and trajectory through thermodynamic, electrostatic or other technical approaches.

Nanotechnology not only has exerted its influence in making versatile fiber composites but also has had impact in making upgraded chemical finishes. One of the trends in synthesis process is to pursue a nanoscale emulsification, through which finishes can be applied to textile material in a more thorough, even and precise manner. Finishes can be emulsified into nanomicelles, made into nano-sols or wrapped in nanocapsules that can adhere to textile substrates more evenly. These advanced finishes set up an unprecedented level of textile performances of stain-resistant, hydrophilic, anti-static, wrinkle resistant and shrink proof abilities.

With one hosiery company producing a line of seamless undergarment for the military that has anti-infection qualities, one could imagine that perhaps some nanosubstance could be part of the equation.

The possibilities or applications for textile, hosiery and other apparel will be broad.

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Already companies have employed nanosubstances to better waterproof or windproof fabrics.

In the future, look for clothes with additional electronic functionalities.

BENEFITS

The benefits association with nanotechnology is as broad as the future materials that will be produced with nanosubstances.

Hinestroza points out that one of the very real benefits in working with nanotechnology is the efficiency involved. Engineering a substance that colors fabrics could drastically reduce the amount of materials used in dyeroom operations. Creating fiber that has anti-stain or antimicrobial characteristics engineered into the material is another material-reduction possibility.

That material-saving aspect of nanotechnology is not limited to hosiery and textiles. When one begins to ponder the resource-saving potential for nanotechnology – with oil and other resources strained as the population continues upward – its easy to see the reasoning behind the talk of a new industrial revolution.

And there's another benefit from nanotechnology for hosiery and textile manufacturers, especially domestic ones.

As more and more products are being produced in low-cost countries, many industry observers believe the future of the small to medium manufacturer will be specialty markets that cater to consumers looking for

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high-quality and highly functional apparel.

A ground-level entrance into nanotechnology may be a niche worth pursuing.

Qiam and Hinestroza speak to a broader benefit in their closing remarks: "Undoubtedly, nanotechnology holds an enormously promising future for textiles," the researchers write. "It is estimated that nanotechnology will bring hundreds of billions dollars of market impact on new materials within a decade; textile certainly has an important share in this material market. We expect to see a new horizon of textile materials under this irresistible technology wave."

HOW TO GET IN ON 'NANO"

With universities and other research centers already at work on many areas of nanotechnology, the availability of information on the subject isn't scarce. But what one will find at most of those research universities is they are 10 years out or better with much of their work.

As Hinestroza stated, he's working on solving some of the very complex challenges of working on the molecular level. That type of research is not aimed at producing a fiber that resists stain – although it could produce the result if it hasn't already.

Nano-Tex is reportedly becoming widely known for its nano-engineered fabrics that repel stains and control moisture. Nano-Tex is currently a supplier for Burlington Industries.

There are other companies working to develop products that employ nanotechnology.

Nanotechnology can also be used in the opposite manner to increase the ability of textiles, particularly synthetics, to absorb dyes. Until now most polypropylenes have resisted dyeing, so they were deemed unsuitable for consumer goods like clothing, table cloths or floor and window coverings. A new technique being developed is to add nanosized particles of dye-friendly clay to raw polypropylene stock before the extrusion.

Any manufacturer making a foray into what is out there today in terms of nanotechnology products and applicability probably would do well to contact Zyvex Corporation, a Richardson, Texas-based firm that is described on a United Business Network website as "the first molecular" nanotechnology company.

Marni Rutkofsky, a Zyvex chemist and technical sales representative, says providing manufacturers with real-world applications in one of the primary objectives of the company. The company has three separate product lines: NanoSolve – materials that offer greater functionality in terms of thermal, electrical and mechanical properties; NanoWorks – tools for micro and nnoscale research; and MechTile – structures for microassembly.

The company's financial report speaks to its success in meeting its objectives. In 2002, the company reported revenue at $1.2 million. By the end of this year, the company expects that figure to exceed $10 million.

Rutkofky said the company's premise is commercializing nanotechnology to address real-world applications with high growth potential.

In 2004, Zyvex experienced a 225-percent increase in customers.

Rutkofky said Zyvex is expecting its textile and related industries to grow and she sees textiles as one of the industries on the front lines of nanotechnology.

With hosiery manufacturers and textile manufacturers searching for new and innovative products to remain competitive, Rutkofky says it stands to reason that those type players are some of first to get in on the ground floor of nanotechnology.