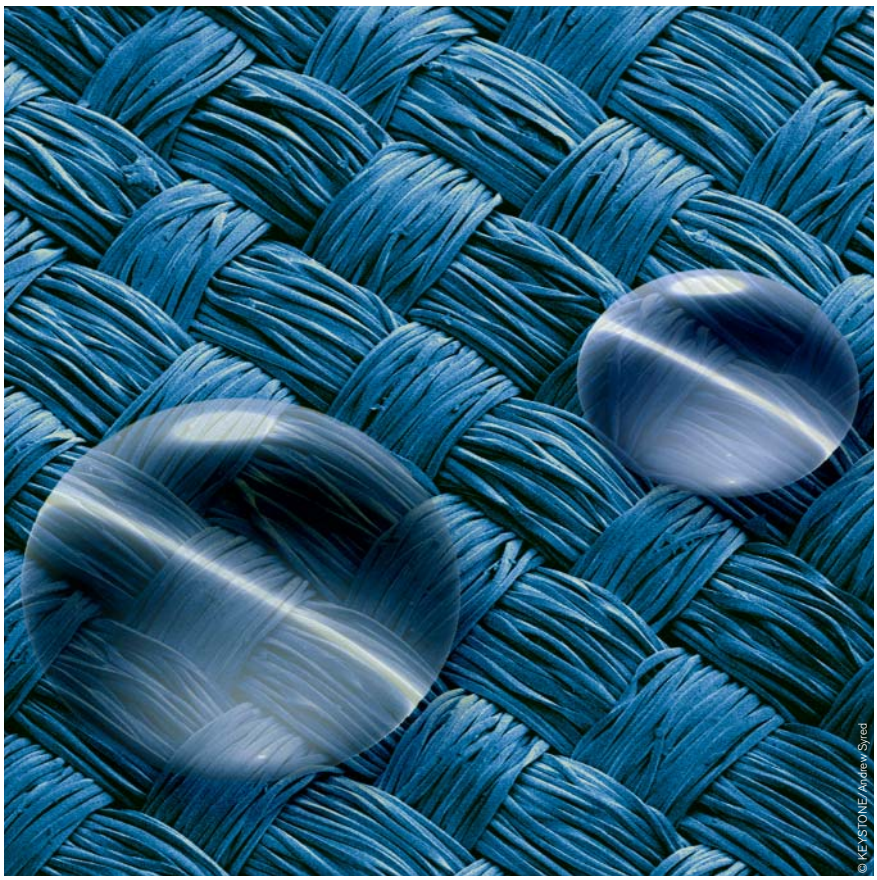
CREDIT SUISSE

June 2008

Nano Circle

Innovative Technologies and Trends

Contents



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The Stuff Dream Clothes Are Made Of

The development of functional textiles is making giant leaps forward. Clothes that are water- or dirt-resistant, that dry quickly, or that fight undesired microorganisms can improve our lives. There is even a move to develop clothes that can create energy for portable electronic devices – an enormous advancement. Read about the role nano-technology is playing in bringing these dreams to life in this issue of the Nano Circle newsletter.

Dear Readers

Our interest in clothing is often limited to their appearance and ease of care. Researchers and innovative entrepreneurs, however, have been exploring the innovative potential of fabrics and textiles for a long time. The buzzword in the industry is "intelligent textiles." The term refers to a completely new dimension of functionality: Microstructures, once touted as revolutionary in their own right, now often serve merely as the basis for clever nanotechnology applications. Read more about this exciting development in this Nano Circle newsletter.

I am particularly pleased to report on the progress under way in all aspects of nanotechnology and finance in this fifth issue of our newsletter. In addition, we have modified the layout of the Nano Circle newsletter in line with our expanded activities, and increased its length. Page 3 gives you an overview of how the market has developed since the last issue, and which interesting innovations we can expect to see in the weeks and months to come.

Are you interested in a particular event or publication? Write to me at nano.circle@credit-suisse.com or contact your relationship manager.

Dr. Arthur Vayloyan
Private Banking
Head of Investment Services and Products

Credit Suisse Global Nanotechnology Index

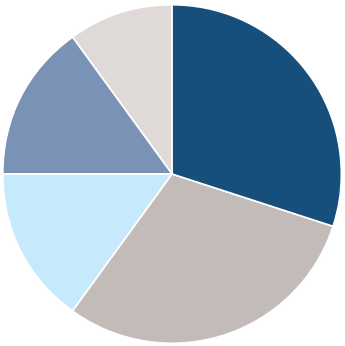
Performance to Date

in %

Credit Suisse Global Nanotechnology Index
MSCI World
Nasdaq Composite

Source: Bloomberg, Credit Suisse

Sector Weighting of the 25 Index Members



Nano Materials 30%
Nano Information Technology 30%
Nano Healthcare 15%
Nano Energy and Other 15%
Nano Tools 10%

Source: Credit Suisse

The Credit Suisse Global Nanotechnology Index was conceived to portray the development of the nanotechnology market as accurately as possible. Since its launch in June 2007, the index has clearly outperformed both the broadly based MSCI World and the Nasdaq Composite technology index (Credit Suisse Global Nanotechnology Index: +17%, MSCI World: –4%, Nasdaq Composite: –3%).
The sub-sectors Nano Energy and Nano Healthcare have been the main growth drivers to date.

Newsticker

Nanotechnology and Innovation

Research	
31.3.2008	UCLA researchers developed "nanoimpeller," a novel type of nanomachine that can capture and store anticancer drugs inside tiny pores and release them into cancer cells in response to light
31.3.2008	Swinburne University of Technology researchers work on a nanostructured CD with data storage capacity of 200,000 DVDs
14.2.2008	Georgia Tech researchers demonstrate that textile fibers covered with zinc oxide nanowires can generate electrical current

Market	
25.4.2008	Z-Medica's nanomaterial-based QuikClot® wound dressing technology which stops severe bleeding within seconds has been applied in 103 cases to date with a 92% efficacy rate
31.3.2008	Nextreme Thermal Solutions™ received seminal US patent in nanotechnology to boost efficiency of thermoelectrics
25.3.2008	NanoBioMagnetics received US patent for improving hearing with magnetically responsive nanoparticles implanted in the organs of the middle ear
11.3.2008	GE demonstrates key step to drastically reduce costs of Organic Light Emitting Diode (OLED) fabrication by printing them "roll-to-roll" like newspaper
6.3.2008	Konarka Technologies demonstrates inkjet-printed organic solar cells
5.3.2008 9.2.2008	Recently completed Nanotech Initial Public Offerings (IPOs): Japanese biotech company NanoCarrier (5.3.2008); Canadian capital pool company Nanotech Sciences (9.2.2008)

Politics & Society	
24.3.2008	A report from Friends of the Earth identifies at least 104 food and agricultural products on sale in the EU containing nanomaterials or nanotechnology with consumers unaware of this
12.3.2008	European Institute of Innovation and Technology (EIT) is set to start operating this summer after final approval by European Parliament
8.2.2008	European Commission adopts Code of Conduct for Responsible Nanosciences and Nanotechnologies Research

Nano Highlights 2008

This year, Credit Suisse is once again supporting a series of nanotechnology events

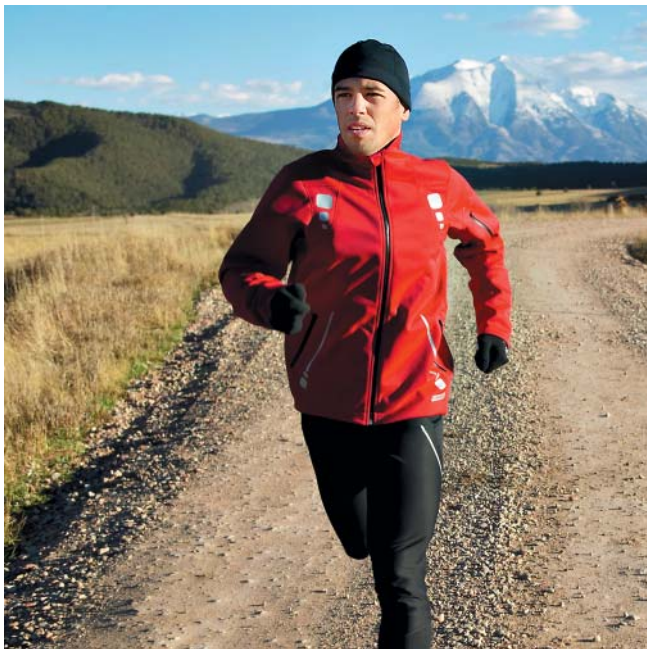
"Nano – Kleines ganz gross" (Nano – Small Is Big)	
1.4. – 1.11.2008 (various dates)	Traveling exhibition at seven shopping centers in eastern Switzerland www.nano-ausstellung.ch (in German only)

Credit Suisse Global Nanotechnology Conference, London, UK	
17.6.2008	Investment conference on the opportunities and risks in nanotechnology www.csfb.com/conferences/nanotech

2nd International Conference on Nanotoxicology, Zurich	
7. – 10.9.2008	Conference of leading scientists on the biological effects of nanoparticles www.nanotox2008.ch

NanoEurope, St. Gallen	
16. – 17.9.2008	Congress and exhibition; this year with a special focus on the links between industry and science www.nanoeurope.com

The traveling exhibition "Nano – Kleines ganz gross" (Nano – Small Is Big)



Textiles – A Pioneering Industry since the Dawn of Time

People are placing ever greater demands on their clothing. Clothes are not only supposed to be attractive, they must also repel dirt, bacteria, and water. Nanotechnology is making an important contribution in this area.

Textiles are nearly as old as civilization itself. The first evidence of clothing dates to the Stone Age, and spindles are considered one of the first human inventions. Until the 18th century, textiles were mainly produced for personal use, and only excess clothing was sold to traders. The textile industry blossomed into an important sector of the economy during the industrial revolution. With its unique technology, Britain became the world's largest exporter of textiles. However, it lost this status with the rise of international competition – mainly from Asia, where the large number of unskilled workers continue to ensure cheap production and thus a decisive competitive advantage.

Nanotechnology as an Engine for Growth

Nowadays, the western textile industry must set itself apart from Asian countries where production is cheap by using high-tech materials. In view of the textile industry's innovative history, it is no wonder that nanotechnology has found its way into this sector so quickly. Nanotechnology contributes to innovation in two ways: improving existing materials and discovering new materials and production processes. Nanotechnology will probably first be employed in those areas where the primary aim is to improve the performance of a textile, not to reduce costs. Such areas include the markets for athletic, outdoor, and protective clothing as well as “technical textiles.” Technical textiles are used in less conventional areas, such as construction textiles, medical applications, and seat covers for use in public transportation. As most of the companies active in this area are small or medium-sized enterprises, cooperation with research institutions is imperative.

Innovations in Switzerland

Switzerland is well positioned in the global textile sector, not least thanks to Empa (Swiss Federal Laboratories for Materials Testing and Research). Empa has become an authority in plasma technology for functionalizing textiles in recent years (see guest article by Dr. Dirk Hegemann).

Another driving force has been Schoeller Textil AG, a worldwide leader in innovative textiles based in Sevelen. In September 2007, Schoeller Textil AG entered into a strategic partnership with Clariant International AG to produce and distribute NanoSphere®. Textiles finished with NanoSphere® are self-cleaning; both dirt and liquids, such as water and oil, roll off the surface. Even honey can be rinsed off easily using water.

To give them their protective quality, the textiles are finished in a water bath, which deposits the nanoparticles on the individual fibers. The nanoparticles are attached to the textiles in gel form and thus do not come loose when they are worn or washed. The NanoSphere® technology has been used successfully by the clothing companies Mammut and The North Face on selected outdoor apparel.

From the Ancient World to Hospitals

The anti-bacterial property of silver presents another application for textiles finished using nanotechnology. Clinical applications, ranging from bandages to silver plates for burns, are particularly promising. For example, Toray Industries, Inc. uses silver-treated material in hospitals to fight the spread of antibiotic-resistant bacterial strains. Surgical towels and other textiles prevent the spread of infections thanks to a silver finish that kills bacteria within an hour.

The healing power of silver was already taught by Hippocrates, the father of modern medicine, and it was also known to the Romans. It is thought to have a three-pronged anti-bacterial effect: silver ions attack the cell walls, interfere with the DNA, and disrupt the breathing of microorganisms. Silver's anti-bacterial power can also be used in athletic apparel to combat body odor. Body odor is caused by microorganisms that decompose our sweat, releasing the unpleasant smell associated with it.

Intelligent Textiles – Energy from Your Vest Pocket

Intelligent textiles (or e-textiles) have electronic components built directly into the fabric, allowing wearers to control their MP3 player or cell phone with their sleeve. Another revolutionary application involves the extraction of energy from textile materials. In addition to research into textile solar cells, there have also been promising attempts at the Georgia Institute of Technology to extract energy from fibers with zinc oxide nanowires that convert mechanical energy into electricity using the smallest movements, such as a light breeze or slow motion. It might be possible to design shoes or clothes that can help power mobile devices. However, there are still a few hurdles that have to be cleared – such as suitability for everyday use and costs – before such products are ready for the market.

Dr. Thomas C. Kaufmann
Private Banking, Equity Sector Research,
European Pharma and Nanotechnology

Nature serves as a model for nanotechnology

Desired Material Properties	Possible Uses	Nanotechnological Solutions
Self-cleaning, water- and dirt-repellent	Outdoor and everyday clothing, interior textiles, seat covers	Silicon dioxide (SiO_2) magnesium oxide (MgO) titanium dioxide (TiO_2) nanoscale surface structure (3D)
Odor-inhibiting	Sportswear and everyday clothing, interior textiles	Silver ions (Ag^+) zinc oxide (ZnO) cyclodextrine (basket-shaped starch molecules)
Antimicrobial effect	Hospital textiles, cooking aprons, treatment of neurodermatitis	Silver ions (Ag^+) zinc oxide (ZnO)
UV protection	Everyday clothing	Titanium dioxide (TiO_2) zinc oxide (ZnO)
Abrasion resistance	Outdoor clothing, interior textiles	Ceramic nanocoatings, clay nanoparticles (particularly aluminum silicate)
Flame retardancy	Protective clothing, seat covers	Carbon nanotubes, clay nanoparticles (particularly aluminum silicate)
Conductivity	e-textiles	Iron (Fe) iron oxide (Fe_2O_3) carbon nanotubes
Tensile strength	Protective clothing (bulletproof vests), sails, parachutes	Carbon nanotubes, clay nanoparticles (particularly aluminum silicate)

Source: Credit Suisse, Cientifica, Hohensteiner Institute

Nanotechnology Revitalizes Textiles

The Swiss textiles industry is seeking new functionalities for textiles in a bid to boost added value and remain competitive in the world marketplace. It also exploits the potential of nanotechnology when developing dirt-repellant and antibacterial fibers.

Nanotechnology essentially offers three advantages: large, specific surface areas that offer a high level of functionality, new types of properties due to the small scale, and minimal use of materials – thus conserving resources. These advantages are particularly useful in the case of textiles. First, the structure of fabrics (microfibers) means they already have a high specific surface area; second, finished surface areas are designed to retain textile properties such as strength, flexibility, permeability, and grip. The specific surface area (surface area in relation to the quantity/weight of material) is increased further by nanotechnology, without impairing its characteristics. Nanoscale or nanostructured coatings, i.e. the encapsulation of nanoparticles, and textiles thus make an ideal combination. "Nano" textile products are therefore expected to generate high sales of more than 100 billion Swiss francs worldwide.

Plasma coating of yarns

Natural Role Models

In the finishing process, the micrometer structure of textiles is exploited and combined with a nanostructure. Examples include stain-repellent and 100% waterproof fabrics. Both are inspired by nature: The leaves of many plants have a textured structure (micro) with wax crystals (nano). Owing to the trapped air and small contact area, dirt does not stick properly and can be rinsed off with water. The air trapped between microfine and nanofine hairs is also used by aquatic spiders, which can thereby breathe under water and do not get wet.

These sorts of finishes are already used in outdoor clothing, tents and tarpaulins, as well as for ties and swimwear. Anyone who has rinsed off splashes of ketchup or salad dressing easily under the faucet, or emerged from the water with dry swimming shorts, will appreciate these developments. Efforts to stabilize these effects are currently under way to ensure they do not fade after just a few cycles in the washing machine. In nature, the sensitive structures simply grow back again.

Combining Properties to Get the Best Results

One of the highly promising new approaches includes plasma technology, which is under intensive development at the Swiss Federal Laboratories for Materials Testing and Research (Empa). This technology involves exposing textiles to a reactive gas – plasma – in order to trigger stripping and coating processes on the fiber surfaces. Plasma technology is increasingly replacing wet-chemical processing steps – and that is also good news for the environment. Through the systematic build-up of coatings in the nanometer area, plasma coatings – with integrated, nanoporous, and functional groups – offer new opportunities for the permanent binding of chemical or biological molecules. These give us multifunctional textiles, where properties such as wettability, conductivity, colorability, cell adhesion, and antimicrobial effect, can be combined.

Silver-coated yarn

Silver-coated yarn in knitwear

Functionalized knitwear

Antibacterial with Silver

Silver is increasingly being used for its antibacterial effect. The extracted silver ions show a toxic effect on bacteria and fungi, where different modes of action prevent resistance from building up. To increase the surface area and minimize the quantity of silver, silver nanoparticles are used primarily, e. g. added to a polymer during the spinning process. After processing, however, the release of silver ions has to be ensured.

Plasma technology can once again be used to produce silver coatings on textiles and yarns. The reactive plasma ejects atoms from a silver target, which then settle on the textile and produce nanoscale coatings directly on the surface. If a plasma polymer coating is deposited simultaneously, the silver content can be adjusted in a precise manner. This ensures that the silver nanoparticles encapsulated in the coating have an antibacterial effect, while still permitting cell growth. It is of particular interest in the case of implants and dressings for wounds. Silver-metallic yarns also exhibit excellent electrical conductivity, in which the textile properties are retained. The yarns may be woven or embroidered into textiles. In the future, textile conductors and electrodes will enable data transportation in clothing and ECG measurements through T-shirts.

Care Reduces Risk

Though nanotechnology offers myriad opportunities, the risks associated with nanoparticles must also be considered. Released nanoparticles such as fine particles can be absorbed via the lungs and result in heightened stress in cells, depending on their concentration. In the case of textile products, however, any increased concentration or exposure to particles occurs at the manufacturing and disposal stages only. On the other hand, no measurable quantities of nanoparticles are released during the laundering process. A textile product also comes into play in this regard: Electrospun nanofibers, which produce a fibrous web on a filter material, enable the effective filtration of nanoparticles.

The careful use of nanotechnology therefore provides the textiles industry and customers with new types of functional clothing and industrial textiles that are beneficial to the protection and wellbeing of the human body.

Dr. Dirk Hegemann
Advanced Fibers Department
Empa, St. Gallen

Dirk Hegemann holds a doctorate in materials science, and has worked at the Empa in St. Gallen since 2003. He manages the “Plasma-modified surfaces” group, which is involved in tapping plasma technology for textiles and transferring it to the industry. Before joining Empa, he spent eight years at the Fraunhofer-Institut IGB in Stuttgart, where he concentrated on plasma technology.

EMPA
Materials Science & Technology

Empa in Brief

Interdisciplinary research and service institution of the ETH domain. The institution aims to transform research findings into marketable innovations in order to increase the competitiveness of the Swiss economy and enhance the quality of life in society.

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