*newsletter*

# Nanotechnology
## and its fields of application

**Nanotechnology is today viewed throughout the world as a ground-breaking technology of the future. Consequently, it is attracting an increasing amount of interest, and its potential and the risks involved in it are the subject of intense discussion in the financial and insurance industries.**

**Introduction**

Experts had an idea of the far-reaching potential of nanotechnology even 40 years ago. And for around 20 years scientists have had the tools they need in order to work on the nanoscale. One milestone here was the development of the scanning tunneling microscope (STM) in 1981, which won the Nobel Prize in physics in 1986 for Binnig and Rohrer, scientists from Germany and Switzerland, respectively. The basic research carried out into nanotechnology is now bearing fruit in the form of an increasing number of commercial applications. Today's commercial applications are found primarily in the field of ultra-thin films and nanoparticles, for which there are a wide variety of applications. Yet there is still much to be done to develop and commercialize the products – products that may well revolutionize many high-tech industries, including electronics, automotive engineering and medical technology.

**A definition of nano-technology**

Nanotechnology is a generic term encompassing a wide range of different technologies. These have in common that they involve creating, researching and using extremely small structures of less than 100 nanometres in size (a nanometre is a billionth of a metre). Owing to the special material properties of nanoparticles, they have the potential to open up totally new fields of application or new technologies for the further development of existing fields of application. The opportunities and risks associated with the various technologies for creating and using these particles will be as diverse as the technologies themselves.

Nanotechnology is a horizontal technology with potential applications in all branches of science and engineering. But a high level of interdisciplinary collaboration will be required in order to exploit the associated opportunities.

**The scale of nano-technology**

Measurements in nanometres take you down to the level of atoms and molecules. One nanometre is the length of a chain of five to ten atoms or the diameter of a simple organic molecule. That is around a ten thousandth of the thickness of a human hair. Materials consisting of particles that can be measured in nanometres have specific properties and demonstrate phenomena that cannot be observed in materials consisting of larger particles. This is because objects on the nanoscale have a huge surface area relative to their volume and thus a higher number of surface atoms, which have a higher reactivity than the atoms inside the object. Materials consisting of nanoparticles therefore generally have a higher reactivity than other materials.

**A vision of nanoscience**

In addition to very simple things, the natural world also contains very complex beings and systems that are able to reproduce and preserve themselves. The ability to study what happens on the nanoscale improves our chances of being able to understand elementary principles of construction in nature, such as the development of chemical, biological and physical structures and objects at the molecular level. We can then implement our findings in the form of new developments or new technical systems.

**Fields of application today**

Nanotechnology is already making a significant contribution to the further development and improvement of products by allowing the newly discovered properties of nanoscale materials to be exploited. The primary objectives of product development are often formulated in response to demands for significantly reduced size, weight, volume or energy consumption as well as improved performance or effectiveness. Since nanotechnology can often bring about several of these improvements at the same time, a wave of innovation is expected in virtually all high-tech industries.

There are already many products in established fields of application that have been improved as a result of nanotechnology research findings, such as:

- LEDs that output more light yet generate less heat
- Electronic devices (CD/DVD systems and mobile phones, for example) with optimized storage batteries or new types of ceramics
- Oxides on the nanoscale as physical filters in sunscreens, textiles that provide protection against the sun, enamels or UV-reflecting films for agriculture
- Nanometre-thin protective coatings to protect surfaces from scratching, tarnishing, algae or other problems in glazing, coats of paint or household appliances
- Paint for cars with chemical protective layers
- Harder-wearing tyres with improved road-holding properties through the use of nanoparticles
- Vitamin pills with improved effectiveness through the use of nanoparticles
- Baby's nappies with improved absorption through the use of nanoparticles
- More effective air-tight cling films with improved resistance to tearing

**Future prospects**

Other nanotechnology products are currently still at the stage of basic research, and it will be years or even decades before they can be marketed. There is a huge variety of possible fields of application and associated visions:

- Automotive engineering: intelligent vehicle responses depending on environmental factors and driving style or behaviour, self-repairing paint and a host of other possibilities
- Chemistry, pharmacy, medicine: new kinds of diagnostic and therapeutic approaches, biochips for medical diagnostics, pharmacological depots, programmable materials, membranes for exhaust emission control, super absorbers, catalysis
- Information and communication, electronics: technologies for high levels of integration, multifunctional devices, mobile I&C centres (body electronics), polymer electronics, digital co-pilots
- Optics: optoelectronic components, data carriers with nanostructures, x-ray optical systems, nanoparticles for photographic films
- Biotechnology: biochips, microsystem technology with nanoanalysis, biocatalysts

- Power engineering: highly efficient, autonomous supply of power to mobile devices (batteries, storage batteries, fuel cells), colour-sensitized solar cells
- Mechanical and plant engineering: ultra-high-precision processing, manufacture of nanostructures, plants for nanobiotechnology and nanochemistry

**R&D activities, economic significance and market potential**

Nanotechnology is regarded as a key technology throughout the world, and many large companies are therefore carrying out industrial research on a significant scale in this field, particularly in the USA, Japan and Europe. In Europe Germany is leading the way. Governments around the world are subsidizing research to the tune of around 2.4 billion euros (2004), 800 million of which is accounted for by Japan, 850 million by the USA and 740 million by Europe (including 290 million by Germany).

Already developments in nanotechnology have led to the growth of a global market with an estimated value of around 100 billion euros and accounting for around 500,000 jobs. This market is expected to grow in size to 1,000 billion euros in the next ten years.

**Information for the underwriter**

In view of the great variety of possible fields of application it is safe to assume this will have consequences for the insurance industry.

The exposure of property insurers will manifest itself in the form of high value concentrations, as a result of the high-tech systems required, and plant interruption risk.

For third-party liability insurers, environmental and product liability are likely to be the primary concerns. Nanotechnology enables a high level of functionality to be achieved with a minimum of material, so it can be viewed as a resource- and energy-saving technology. This does not necessarily result in greater environmental compatibility, since nanoparticles are more reactive than macroscopic materials.

As far as product risk is concerned, clearly new fields of application generally bring new risks. The level of exposure depends on the product, its field of application and the findings in relation to the product's safety and compatibility. In this connection, subjects currently under discussion are the possibility of nanoparticles interacting with the human body, the possibility of bioaccumulation and the effects of nanoparticles on the environment. In many cases, certification authorities are not demanding new tests for nanotechnology products when the substance used has already been tested and found to be unproblematic above the nanoscale.
These issues are considered in detail in the Swiss Re publication *"Nanotechnology – Small matter, many unknowns"* which was published in May 2004.

**Conclusion**

Given the complexity of the products and their applications, it is very important to carry out an interdisciplinary risk assessment, taking into consideration the acceptability of the technology to society, and to conduct a dialogue with industry about the risks involved.

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