Media communiqué

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nanoconvention 2009

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A Platform for Dialog on Nanotechnology

Overcoming the Big Challenges with «Nano»

Whether in the fields of medicine, sustainable energy supply or environmental protection, without making use of nanotechnology we will not be capable of overcoming the challenges which the future presents. In parallel with these efforts, though, it is essential that we examine the new technology very carefully for potential risks, such as those presented by free nanoparticles. This is the conclusion drawn at the close of Empa's 3rd NanoConvention, held on July 6th in Zurich and attended by about 150 nano-interested persons from the areas of research, industry, administration and the financial sector.

The aim of the NanoConvention is to establish nanotechnology as a secure and safe motor of innovation for the Swiss economy and society. "The past has taught us that new technological developments will always find their way out of the ivory tower and into the real world, into the hands of the man in the street", explains Hans Hug, the head of Empa's Nanotechnology Research Program. An early, open dialog - as broadly based as possible - on the opportunities and risks involved is therefore necessary.

This is an area in which Wolfgang Heckl, a physicist at the Ludwig Maximilians University and Director General of the Deutsche Museum in Munich, has long been active. "On the one hand, people are fascinated by hidden research", according to Heckl. This is particularly true of nanotechnology, which of course is invisible to the human eye. On the other hand, many people are made uneasy by the slivers of information they obtain from the media about what nanotechnology is allegedly capable of doing.

Transparency in the «glass» laboratory

In order to render the nanosciences more transparent, the Deutsche Museum, which is the largest scientific and technological museum in the world (boasting about 1.5 million visitors annually), is currently constructing a glass Nanolaboratory. From November physicists, chemists, molecular biologists and material scientists will work in the «Center for New Technologies» under real-life conditions, affording visitors a glimpse into the world of nanotechnology. Heckl – who for his efforts in disseminating science and technology matters to a wider audience was honored with the European Commission's Descartes Prize for Science Communication,

among other awards – is convinced that credibility and trust can only be built up when "…people understand, in the truest sense of the word, not just the nano research but also the researchers themselves."

How society deals with new technology, what ethical and societal consequences nanotechnology brings in its wake – these are questions which occupy the mind of Alfred Nordmann, the head of the «nanobüro» at the Technical University of Darmstadt. A philosopher, Nordmann warns against adopting a «speculative» or «futuristic» ethical model which looks far ahead and attempts to take account of every possible (and impossible) future application. "Instead of trying to predict all the imaginable uses of nanotechnology and estimate their effects, we should really be worrying about questions which influence research into nanotechnology today", he maintains.

In the field of medicinal diagnostics, for example, already today the greatest fears are concentrated around the question of how we should approach the new diagnostic tests, expected to be available in the future, for currently incurable diseases. In Nordmann's opinion, "…perhaps we should spend more time worrying about how a personalized system of medical care – a trend which is already visible today – will change the relationship between doctors and patients."

Nanoparticles in the battle against cancer

That diagnostic processes are already markedly better thanks to nanotechnology is shown, for instance, by a blood test for colonic cancer which Gerd Grenner, CTO of Roche Diagnostics, presented at the conference. In this method the blood sample is tested for six different proteins, which are indicative of the disease, in so-called microarray chips. By making use of nanoparticles, which, depending on their size, fluoresce in different colors, the six tumor markers can be simultaneously identified. This increases the sensitivity of the tests – that is the fraction of subjects correctly identified as having the disease – from about thirty per cent using a single protein to seventy per cent.

Nanotechnology is also promising in terms of therapeutic applications. Andreas Jordan, with his company MagForce Nanotechnologies AG, has for example developed a novel cancer treatment which allows doctors to inject magnetic nanoparticles directly and precisely into tumors with the help of a three dimensional imaging technique. When an oscillating magnetic field is applied, the nanoparticles (and the tumor containing them) heat up to up to 75 degrees Celsius due to magnetic coupling effects. This heat destroys the tumor, while at the same time the surrounding healthy tissue is hardly damaged.

The idea of using heat to destroy tumors has been around for a long time, according to Jordan. However, until now it has never been possible to heat the tumor selectively without affecting the surrounding tissue. "This breakthrough will be made possible thanks to nanotechnology", says Jordan with conviction. The results of clinical studies on patients suffering from a glioblastoma – a particularly malignant brain tumor – have been encouraging. According to Jordan the average life expectancy of a patient about a year after diagnosis was "significantly increased" and detailed results are expected to be published by the end of the year.

Nano sandwich structures make solar cells more efficient

Besides medicinal applications, questions of energy and environment occupied centre stage at the NanoConvention. How, for instance, do we satisfy our ever increasing hunger for energy when crude oil reserves are exhausted? The obvious answer: think solar. Solar cells have been converting sunlight into electric power for years now. Christophe Ballif and his team at the «outpost» of the EPF Lausanne at the University of Neuchâtel have been developing solar cells based on silicon thin films. The advantages when compared to conventional solar cells are reduced material requirement and energy consumption during the manufacturing process.

The downside is that thin film solar cells have poorer efficiency, around ten per cent. Ballif's aim is to increase this figure with the help of nanolayers – ultrathin layers, just nanometers thick, of materials such as zinc oxide which reflect and scatter the incident sunlight. This allows significantly more light to enter the silicon layer where it is converted into electrical current. Ballif is convinced that by employing this method it will be possible to raise the efficiency to up 14 per cent

Results and know-how from the nano cosmos could play a role in solving the "water paradox", as Jean-Pierre Petit of Georg Fischer AG calls it. Clean potable water is predicted to become a rare and therefore expensive luxury in the foreseeable future, even in industrialized countries. On the other hand, there is more than enough water in the oceans to go around – the question is, how to make use of it?

The answer is by using nanofiltration systems, for example. These employ filter membranes with pore diameters of about 10 nanometers which can reliably hold back not just bacteria but also viruses. This technology makes it possible to transform dirty river water or even waste water into drinking water. A plant of this kind exists in Singapore, a city-state which has no natural sources of potable water. Membranes with even finer pores which are permeable to water molecules but not ions are used in the reverse osmosis process. In a technique which reverses the natural effects of osmosis, dirty water is pressurized to overcome the concentration gradient and passes through the filter. Using this technique it is possible to produce drinking water from sea water.

Standardized testing procedures are in demand

Despite all the optimism, the potential risks associated with the applications of nanotechnology were not forgotten. In mid-June the German Federal Ministry of Education and Research's «NanoCare» project drew to a successful close. Under the leadership of Empa's Harald Krug, 16 partners from industry and research worked to standardize risk evaluation procedures for nanomaterials and nanoproducts. These included methods to determine the toxicity of nanoparticles to rats with the help of cell tests and inhalation studies, and procedures to measure the uptake of nanoparticles in body cells. "Standardized procedures have been completely absent in the field of nanotoxicology to date. Everyone has been testing what they wanted, however they wanted. This explains the fact that some results are completely contradictory", maintains Krug.

The NanoCare consortium is concentrating on the 11 most frequently employed nanomaterials such as zinc oxide (used in cosmetics), barium sulfate (used to stabilize plastics), strontium carbonate (used in ceramic glazes) and titanium dioxide, which is used in sun creams and many other products. Provisional results indicate that, as far as is currently known, the tested materials represent no cause for alarm. However, Krug, a toxicologist, does admit that chronic effects have not yet been adequately investigated.

So the nano-researchers are not likely to run out of work any time soon. But the feeling at the NanoConvention was unanimous in that these efforts were very much worth while. Péter Krüger of Bayer Material Science AG hit the nail on the head when he said “Nanotechnology is not THE solution to the greatest problems of the future, but it is certainly one of them.”

Further information

Prof. Hans Hug, Head of Nanotechnology Research Program, +41 44 823 41 25, hans-josef.hug@empa.ch
Prof. Harald Krug, Materials-Biology Interactions, +41 71 274 72 74, harald.krug@empa.ch

Editor / Media contact

Dr. Michael Hagmann, Communication, +41 44 823 45 92, michael.hagmann@empa.ch

This year as always the NanoConvention offered participants the chance to engage in animated discussion: Paul Gilgen (Empa), Christopf Gerber (University of Basel), Stefan Fahr (Swiss MNT Network), Wolfgang Heckl (LMU Munich), Ingrid Kissling-Naef (CTI; l. to r.).

The attentive audience at the NanoConvention 2009, held at the Swissôtel in Oerlikon, Zurich.

During the breaks the «Nano – Kleines ganz gross» exhibition put on by the MEMS-Point Network encouraged participants to delve into the world of atoms and molecules.

Images in print resolution quality can be downloaded at www.empa.ch/bilder ; the text in electronic format is available from redaktion@empa.ch