

Media communiqué

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Lively discussion on the opportunities and risks Nanotechnology presents

Applied correctly, the technology of the «extremely small ones» has an enormous potential

Nanotechnology is flying high. That was amply shown by the fact that the Bern Kursaal was filled to capacity last Thursday and Friday for the second edition of the Swiss NanoConvention. The public in attendance was at least as varied as the topics presented, ranging from a member of the Swiss Federal Council to international “Big Names” in Nano, industry representatives, insurance and finance experts as well as lawyers, philosophers and ethicists. Altogether about 300 persons accepted Empa's invitation to take part in discussing the «key technology of the 21st Century», and its effects on science, economy, health, environment and society.

And that they did extensively and at times heatedly for two days. «Where different interests and views clash with one another, exciting dialogs and possibly new starting points ensue», said Empa CEO Louis Schlapbach contentedly. «Empa's goal is to prepare the necessary basis so that nanotechnology can be used where it promises society the greatest good, and exercise caution where the risks outweigh its use.» The NanoConvention is imbued with this philosophy.

Empa's initiative bridges the chasm between «Nanohype» and gloominess and is timely, stated Federal Councilor Pascal Couchepin in the opening address of the convention. According to Couchepin the convention is most important since it provides an open and practical forum for continual dialogs not only about the opportunities but also regarding the potential risks associated with nanotechnology. In a similar vein, Georg Karlaganis from the Swiss Federal Office for the Environment (BAFU) stated: «The NanoConvention is a substantial contribution to the broader dialog about responsible interaction with this new technology.»

Nano – anything but new

Topics covering the «Fascination», «Innovation» und «Security» of nanotechnology took center stage in the discussions at the NanoConvention. Among the experts a consensus prevailed that «Nano» has an enormous potential. There is hardly a field which will not be sustainably changed through nanotechnological methods. Be it materials science, information technology, biomedicine or environmental technologies – Nano

– or simply said, the manipulation of substances at the molecular level – opens up the possibilities of creating materials with completely new «custom-made» characteristics. Today, we cannot imagine our daily lives without nanomaterials, as was amply demonstrated by the various examples Antje Gerber of Degussa GmbH presented. And this is not something that has taken place only recently. For example, as long ago as 1949 Degussa brought out its first nanoproduct, a silicon oxide which makes infusion tubes more elastic, allows for brilliant bright color printing and for better adhesion of colors, better adhesives, and many other uses. And while, until now, Degussa's emphasis has been on improving existing materials, Gerber envisions that in the future the production of completely new products will be made possible.

Werner Bauer, Chief Technology Officer of Nestlé, pointed out that nano is not a new concept in food technology. «Milk and ice cream are wonderful examples of nanostructured foods with nanometer large fat droplets and other similarities», said Bauer. However, the introduction of artificially manufactured materials into food products is at present not accepted. «The food industry is very conservative when it comes to the introduction of new technologies.» Such a process would be far easier, simpler and faster in the electronic industry, for example. «After all, how often would you like to ingest a totally unknown food product?», asked Bauer rhetorically.

Where he thinks nanotechnology does show promise is in neighboring fields such as in the production of abrasion resistant, possibly even antibacterially coated machines, in the packaging sector or in sensors and monitors which can indicate in a fast and reliable manner bacterial contaminations or similar occurrences. «In these areas, nanotechnology will make our foods even safer», thinks Bauer. «But in the actual food production I still do not see at the present time any concrete applications for nanotechnology.»

Patrick Hunziker from the Basel University Hospital emphasized the great potential of nanotechnology in medical applications. The nanopolymer containers developed by his team can be filled with an active agent, and after being injected into the body, they track down very specific cells. These absorb the containers which then release their content into the targeted tissues.

Hunziker is convinced that «nanotechnology will in the future be more important in medicine than gene therapy, and this both in therapeutics as well as in diagnostics.»

Nanotechnology as a universal remedy?

Yet, despite, or perhaps because of, all the enthusiasm, nanotech pioneer George Whitesides of Harvard University warned against exaggerated expectations. «Small is not always better, and thus Nano is not always the right answer», said Whitesides. One must engage nanotechnology – the «science of the extremely small», as Whitesides calls it, correctly. At present no one can predict with any surety that nanotechnology will bring about an extensive scientific revolution as occurred for instance with the invention of the wheel, the development of the steam engine or the introduction of electricity.

Arthur Vayloyan, member of the Private Banking Management Committee at Credit Suisse, the main sponsor of this year's NanoConvention, stressed that nanotechnology must never be allowed to be used for selfish purposes but must rather be applied for the benefit of society at large. The greatest future challenges facing humanity will represent the «acid tests», for example providing adequate water supplies to an ever growing world population. «While water is available, it often is either salty or polluted», said Vayloyan. Recently, US

researchers have developed a technique whereby carbon nanotubes are used to desalinate sea water. In order that developments such as these are put into practice as fast as possible, «banks, insurance companies, industry, government and science must all work together», opined Vayloyan. «When we succeed in transferring know-how from research into the economy – and the backers of this research will thereby also profit – then we have a triple-win-situation.»

In order to make it easier for potential investors to become involved with nanotechnology, Credit Suisse launched the «Credit Suisse Global Nanotechnology Index» at the Swiss NanoConvention 2007. This covers 20 globally active firms offering products made using nanotechnology. «Looking back over the past five years, this index has gained around 14 percent annually, which is more than any other index, such as for instance the NASDAQ», remarked Giles Keating, head of Global Research Private Banking and Asset Management at Credit Suisse. He also presented to the audience the “WINS” rating model, developed by Credit Suisse. This allows nanotechnology based companies – which frequently can offer neither historical financial data nor market-ready products for investors to evaluate – to be systematically, objectively and reproducibly rated over a range of industrial sectors.

Both Vayloyan and Whitesides are convinced that in the power supply field also nanotechnological methods will provide enormous impetus for progress. The reason for this, according to Whitesides is simple. «Many of the new energy sources function with the help of components which are of nanometer size, such as solar or fuel cells.» The Harvard researcher also sees a clear improvement due to nanotechnology in the area of electronic data storage. «We will be able to store massive amounts of data at practically no added cost.» This, however, also presents a danger – possible harm to privacy. «Every one will be completely transparent, and all personal data will be accessible », fears Whitesides. This serious problem, also a result of nanotechnology, must be carefully considered by society.

Lurking risks possible, particularly from free nanoparticles

Nanosafety research is at present focusing on the impact of free nanoparticles. When inhaled, these particles can infiltrate deep in the lungs and even penetrate from there into the blood stream, as was shown by electron microscope studies undertaken by Peter Gehr from the University of Bern. There is no protection against such exposure. «We can avoid contact with nanofood or cosmetic products, but we cannot stop breathing», said Gehr.

The inhaled nanoparticles are absorbed by the macrophage cells of the immune system. The function of these cells is to clean foreign bodies from the lungs. But the nanoparticles penetrate right into the red blood corpuscles as well as into other immune cells. In a fascinating fast motion video, Gehr explained how a macrophage cell passed nanoparticles to another cell of the immune system, a so-called dendritic cell. Gehr assumes that these latter cells alarm the immune defense system and cause it to release an immunological response to counter the nanoparticles.

Nanoparticles move practically unhindered within cells they invaded. Gehr's team found tiny polystyrene particles in cell nuclei and the mitochondria, the power house of cells. «What this means is unclear as yet», said Gehr. «But it is possible that nanoparticles can cause chromosomal damage in the cell nucleus.» Further investigations should clarify these matters.

Not all nanoparticles are equal

Not all nanoparticles pose dangers to health. «It is always assumed that nanoparticles are generally more toxic than larger particles of the same substance», pointed out toxicologist David Warheit from the DuPont Haskell Laboratory for Health and Environmental Sciences in Newark in the US state of Delaware. This was demonstrated by Warheit in Bern on the basis of studies with rats which inhaled various nanoparticles. Result: not all nanoparticles are equally toxic, and «each kind of nanoparticle must therefore be examined separately», according to Warheit.

In order to standardize the investigation of the effects of nanoparticles on humans and the environment, and to better measure the risks these nanoparticles represent, Warheit recently, in cooperation with the United States environmental protection organization, «Environmental Defense», formulated generally applicable guidelines. The June 21st presentation of the «Nanorisk Framework» (www.nanoriskframework.com) shows how an effective risk management process can be implemented so as to guarantee responsible handling of nanomaterials. At the same time, Warheit designated ten toxicological tests against which nanoparticles can be examined in the future. For instance, reactions will be examined when nanoparticles are inhaled or applied to the skin or the eye, and the effects of the particles on algae, water fleas or fish. «These tests should give us a relatively reliable 'risk profile' for various nanoparticles», expressed Warheit confidently, who is also the director of the European Centre for Ecotoxicology and the Toxicology of Chemicals. Nanosafety is a matter of concern in Switzerland as well. On behalf of the Federal Offices for Environment (BAFU) and Health (BAG), an interdisciplinary project team, in which Empa participated, has now compiled a report about the management of the risks of synthetic nanoparticles. This report is the basis for an «action plan», which, the federal offices hope, will be adopted by the Swiss Federal Council still this year. «The goal of this action plan is to minimize the possible damaging effects of nanoparticles and protect society and business from consequential costs or bad investments », said Karlaganis from BAFU. In addition, a proposal for a national research program, «Opportunities and Risks of Nanotechnology», was prepared, and hopefully will be acted upon in the second half of the year.

There is no such thing as zero risk – even with nanomaterials

Other convention participants also stressed the fact that the research need in the area of nanosafety is immense. Thus, Helmut Horn from the Graduate School for Applied Sciences in Hamburg and from the Federation of the Environment and Nature Protection in Germany (BUND) stated: «The gaps in our knowledge are in some cases enormous and must be closed as fast as possible».

But even this cannot provide a 100 percent safety margin, which of course does not exist in any aspect of life. Therefore in discussing nanotechnology we must also ask the question of how can our society deal with the issues of uncertainty, suggested Empa researcher Lorenz Hilty. «We will always develop new technologies faster than we can examine them for all possible effects. We shall have to learn how to live in and with this uncertainty.»

Nanotechnology does not differ in this aspect from other innovative technologies of the past. According to Arie Rip of the University of Twente, new technologies always elicit the same reactions, either enthusiastic

acceptance or rejection. «This is a function of their newness; the new and unknown technologies take the place of an established order, and this the public can either greet with acclaim or rejection», said the Dutch expert for technology impact assessment.

«Emigrants from Lilliput »

The German philosopher Peter Sloterdijk pinpointed the origin of man's hostility to technology – his «colleague», the French philosopher Jean-Jaques Rousseau, whose work «Back to Nature» is considered by Sloterdijk to be in fact a «Forwards to Technology». «From the start, man must be understood only as a *Homo technologicus*, as he has always been a technologically oriented animal and will always remain one.» Rousseau's call for man to return to a romanticized nature is therefore impossible.

In addition, nanotechnology embodies a completely new model of technique. As Sloterdijk put it: «Nanotechnology is quite close to nature, since it is based upon biological mimicry and copies natural actions, as it were. In contrast, all other techniques are to a certain extent based on an opposition to natural processes.» Nevertheless, when considering the new technology, one must carefully think about the integration, or «migration», as Sloterdijk phrased it for illustration, of these technological achievements into our daily lives. «We have quasi-naturalized our cars and they already sleep in our homes.» The decision whether to integrate nanotechnology, «the so-called immigrants from Lilliput», still has to be made.

That this decision must be found in social dialogs, is a matter of a wide consensus. Arie Rip confirms that scientists have learned in this way from previous experiences. «Compared to approximately 20 years ago, the time when biotechnology was just introduced, today considerably more importance is attached to technology and society.» Public dialog was actively sought in many countries, as for example with the British «NanoJury», and in this country with the «publifocus Nanotechnologie», conducted by the Center for Technology Impact Assessment (TA-SWISS).

Convention attendees could hardly complain, therefore, about the lack of opportunities and materials for public discussion. Louis Schlapbach, Empa's CEO, would like to see a continuation of public dialog on nanotechnology, particularly outside the convention halls. «Empa will continue its active role in these dialogs, just as it will continue its research into nanotechnology and nanosafety.» The range of lectures from the various disciplines represented at the Swiss NanoConvention were well accepted once again, and voices already called for a further «edition» of the convention. «We shall gladly satisfy these demands at the right time.» promised Schlapbach.

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Federal Councilor Pascal Couchepin opening the Swiss NanoConvention 2007, in the Bern Kursaal.



Philosopher Peter Sloterdijk described man as a Homo technologicus, a «technical animal who will always remain such».



Arthur Vayloyan from the Credit Suisse, main sponsor of the Swiss NanoConvention 2007, talking to Don Eigler, from the IBM Research Center in Almaden, California. Eigler was a guest lecturer at last year's NanoConvention.



A lively exchange of ideas during a break.



About 300 participants follow with interest specialized lectures.