

## Press Release

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### *Interdisciplinary nano dialogue*

## **Nanotechnology requires plenty of thought**

***On Friday, 23 June, Empa hosted the first ever NanoConvention. Around 200 guests with an interest in nanotechnology took up the invitation to discuss the “Key technologies of the 21<sup>st</sup> century” and their impact on science, the economy, health, the environment and society, at the Kursaal in Berne. “The NanoConvention is an attempt to stimulate nano-dialogue in Switzerland across the boundaries of different disciplines,” said Empa CEO Louis Schlapbach. “We therefore felt it important not just to have representatives of Swiss research institutes on board, as they already hold regular meetings. We also wanted to involve manufacturing, the insurance and financial sector, politicians, the public authorities and society at large.” Judging by both the broad mix of participants and, more specifically, the lively debates and uniformly positive reactions, this Empa initiative met with an enthusiastic response. “Empa really must hold such an event again in due course,” were the words of Hans-Joachim Güntherodt, Director of the National “Nanoscale Science” Competence Center at the University of Basel.***

The chasm between the lofty promises of the nano-fanatics and the prophecies of doom of the technosceptics was the central theme of the NanoConvention. Or, to quote nanotech pioneer Don Eigler of the Californian IBM Almaden Research Center, between “type 1 nano-hysteria and type 2 nano-hysteria”. Type 1 hysteria is an irrational ebullience fuelled by greed – such as is encountered in the financial world, for example – while type 2 manifests itself as irrational paranoia fuelled by fears. “Both diseases, which are at opposite ends of the psychological spectrum, share the same problem: the absence of any critical reflection,” says Eigler, whose research group managed, in 1989, to move a number of atoms with the aid of a scanning tunnelling microscope so that they spelt out the IBM corporate logo.

Eigler is in no doubt that nanotechnology has a lot to offer: “Personally I believe that the potential of nanotechnology is phenomenal.” Nanotechnology – put simply, the manipulation of matter at molecular level – enables new materials to be created “to order”, with completely new characteristics. Ultra-thin, scratch-resistant coatings, flat screens made of carbon nanotubes or innovative, non-erasable magnetic data storage products are just a few of the developments that have their origins in nanoscience.

Yet the prospects of new and improved materials characteristics that nanotechnology can deliver are tempered by potential risks – particularly of free nanoparticles. How do nanoparticles behave in the human organism? Or the environment? And how should legislators, employers or, for that matter, consumers handle the new nanomaterials? How is society responding to this technological challenge?

### ***Bridging the divide between science and society***

There's no time like the present for broaching these issues, while nanotechnology is still in its infancy. Although there are already innumerable products using nanoparticles, this is only the beginning, the experts stressed. Which means now is the perfect time to identify and investigate possible risks. Everyone at the event agreed on the necessity of this, if nanotechnology is to be handled in a responsible way; otherwise, research runs the risk of losing the confidence of the population at large.

"I hope that, as scientists, we communicate more successfully with the general public about nanotechnology than we have done on previous occasions," said Eigler. "Because the divide between science and society is at best worrying and, at worst, disastrous." Social scientist Ortwin Renn of the University of Stuttgart also warned against hushing up the risks of nanotechnology. "If the debate is not conducted proactively, the subject will inevitably rear its head elsewhere - but by then, it will be riddled with half-truths." This has, he said, happened quite often in the past.

In Don Eigler's view, nanotechnology is at its most risky when applied without weighing up the consequences. "The extensive distribution of nanoparticles in the environment, although their toxicological effects are unknown, is an example of this." On the other hand, he says, there can never be absolute certainty – and that applies not just to nanotechnology. "It is nigh on impossible to prove that something is absolutely safe. We simply have to proceed with extreme caution and care," urged Eigler. "The question is: how do we, as a society, master the challenge of nanotechnology, so that we can enjoy its benefits while minimizing its risks?"

### ***Switzerland must not miss the boat***

There is no question that nanotechnology holds great promise in the scientific and economic domain – especially in the life sciences sphere, where it can be used in the treatment of diseases. Switzerland should also be able to reap the benefits – after all, it was here that, at the IBM Research Center in Rüschlikon, the scanning tunnelling microscope, in many ways the key to the nanocosmos, was developed. "In Switzerland we need not just scientific but economic success stories in the field of nanotechnology," said Christoph Caviezel, Director of the Swiss Innovation Promotion Agency CTI, which is why the CTI is willing to promote nanotechnology wherever and however it can. Caviezel warned against letting other countries steal a march. "We must guard against one day having to "buy in" expensive know-how for which we ourselves created the foundations."

In Caviezel's opinion, the first warning signs came when the momentum created by the TOP Nano 21 research programme in the years 2000 to 2003 began to falter. In 2003, the CTI received 93 research proposals in the field of nanotechnology; one year on, that figure had dropped to just 17. Talks are currently underway between the CTI and the Swiss National Science Foundation about a follow-on project and what form that project might take. Everyone in Berne agreed on the urgent need for such a project. In the words of Hans-Joachim Güntherodt: "It's not enough to increase the number of projects. What we need is a coordinated network." The Basel-based researcher has a nano-programme in mind "in which everyone can take part: industry, the universities, the Swiss Federal Institute of Technology (ETH) domain and the universities of applied sciences."

***The risks of nanotechnology must be addressed on more than one level***

The less palatable potential of nanotechnology was also discussed at the NanoConvention. The focus of current research in this regard is on investigating free nanoparticles. Harald Krug, an Environmental Toxicologist at the Karlsruhe Research Center, is, among other things, researching how nanoparticles are carried into cells. His (provisional) conclusions: "All the studies in the past found no evidence that nanoparticles could penetrate the organism through healthy, undamaged skin. So the skin provides good protection against nanoparticles." However, the same cannot be said of the lungs, through which the tiny particles can easily get into the human body. In Krug's opinion therefore, "Inhaled nanoparticles constitute the greatest health hazard."

This is because, through the lungs, nanoparticles can spread throughout the body, as has been proved by studies conducted by a team led by Peter Gehr at the Anatomical Institute of the University of Berne. The nanoparticles get into the blood through the epithelial cells which line the lungs and are responsible for the exchange of oxygen between inhaled air and the bloodstream. "Red blood cells then carry them to all kinds of organs – the brain, the liver, the heart", explained Gehr.

Meanwhile, at Empa, the effects of various nanoparticles on cells are being studied in cell cultures. The aim is to devise a quick test procedure which can swiftly and easily measure the toxicity of various nanoparticles. In these studies, Empa researchers led by Arie Bruinink and Peter Wick found that the nanoparticles vary greatly in their toxicity. Next on the agenda for the Empa team is to research what exactly toxic nanoparticles trigger in the cells. With the aid of so-called gene chips, Wick and Bruinink plan to analyse the activity of thousands of genes in order to find out which genetic programme is triggered by the different particles.

There was also animated debate about how the general public perceives the risks, as risk perception in society influences the innovation process and is therefore just as important as the risks themselves. This explains why the insurance industry, which was represented by Swiss Re among others, makes no distinction between actual and so-called pseudo risks: pseudo risks can cause just as much economic damage as "genuine" risks. This is one of the reasons why the insurance industry often adopts a "wait and see" policy with regard to new technologies.

### ***The need for research is huge***

According to Eva Reinhard of the Federal Office of Public Health, there are currently gaps in both knowledge and, more especially, the regulation of nanoparticles. At the moment, nanoparticles are regulated by the Chemicals Act. In future, for instance, the doses in question will have to be re-defined, as the Chemicals Act requires no data on either the size or number of particles, or their surface area – in other words, characteristics which play a crucial role in nanoparticles (and their increased reactivity). Reinhard advocated the labelling of products containing free nanoparticles.

Clearly, the participants in the NanoConvention had plenty to talk about. Empa boss Louis Schlapbach described the convention as a good start to firing up the debate about the pros and cons of nanotechnology. “Anyone who wants to use the opportunities offered by nanotechnology – as does Empa – must acquire the necessary knowledge of both its potential and its possible risks.” This, Schlapbach said, can only be done in an interdisciplinary approach, “as demonstrated by the NanoConvention”. Only then, he feels, can the knowledge gained be used in a creative and responsible way, “in order to supply industry with the necessary innovations – and ensure a high standard of living for us all.”

### **Edited by**

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Alternatively, they can be downloaded from the website [www.nanoconvention.ch](http://www.nanoconvention.ch) or

[www.empa.ch/bilder/nanoconvention](http://www.empa.ch/bilder/nanoconvention).