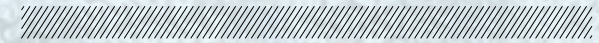


# **/ Nanosciences Live in Science Centres and Museums**



## / A New Approach



'Out of the ivory tower and into the public arena' - this could be the unofficial motto of the NANO TO TOUCH project. With an ever increasing dependency on technology contrasting with a more and more sceptical, even critical public view of modern research, scientists face the challenge of re-integrating themselves into society. For this reason we implemented a radical new approach to science communication in the Deutsches Museum. In 2006, students from my nano-research group at Munich University were first relocated from their dark, inaccessible basement laboratories and brought into the bright public space of the museum. In this so-called 'Open Research Laboratory', young researchers conduct their work live in the midst of the exhibitions whilst answering questions and engaging the visitors in discussion. Not only does this give an insight into the making of science, it also gives

the opportunity to enquire into the individual motives of the young researchers. Thus, this concept, now being exported throughout Europe in the NANO TO TOUCH project, takes science communication a step beyond conventional approaches, initiating and encouraging a Public Understanding of Research.

A handwritten signature in blue ink, appearing to read 'W. Heckl'.

**Wolfgang M. Heckl**

Director-General of the Deutsches Museum,  
Oskar-von-Miller-Chair for Science Communication  
at the TUM School of Education

### Cover photo :

A protein model in the exhibition  
at Deutsches Museum's Centre  
for New Technologies.



# / Introduction

## / NANO TO TOUCH Nanosciences Live in Science Centres and Museums [www.nanototouch.eu](http://www.nanototouch.eu)

NANO TO TOUCH is a project supported by the EU Seventh Framework Programme with the aim of creating innovative spaces where the public can learn about nanosciences and nanotechnology. Research spaces have been especially created in six science centres and museums across Europe to enable visitors to interact with researchers in a totally new way, just stopping by to ask a question or observe the scientists' work as it takes place in the museum. Partner science centres and museums joined forces with nearby universities to set up these unique areas for research and live communication inside the centres' exhibition areas.

The NANO TO TOUCH project is coordinated by the Deutsches Museum and the concept is based on the museum's pioneering experience with a nanoscience researcher working in full public view inside the museum. Two different formats of research area accommodate the science centres' different needs: Open Nano Labs and Nano Researcher Live programmes.

## / Open Nano Labs

An Open Nano Lab is a fully functional nano-research laboratory situated in the public space of a science museum, where researchers from the local university partner spend a few months conducting their work in full public view.

In an Open Nano Lab, visitors gain new insight into the processes and methods of a modern laboratory by observing how doctorate and graduate students obtain data and images from their instruments, and how these are processed or discarded.

This kind of peer-to-peer exchange can help form meaningful connections between science and everyday life, both for adult visitors and for youngsters – providing role models for the next generation of researchers.

## / Nano Researcher Live programmes

The Nano Researcher Live programmes are new formats of event that expand the fundamental idea of live communication in science centres and museums. Exhibits, demonstrations and interactive presentations create a nano-environment centred on a live presentation area where scientists from the local partner universities explain and discuss their current work in a public forum.

## / Training, Dissemination, Evaluation

The National Museum of Science and Technology Leonardo da Vinci of Milan is in charge of training researchers and museum educators from partner institutions during the project lifetime. Two training workshops give researchers tips on communication with non-expert publics and provide all partners with insight into the ethical and societal aspects of nanotechnology.

Ecsite, the European network of science centres and museums, is in charge of the dissemination of the project's objectives and results. The target of dissemination actions is twofold: on one hand science centres or museums and science communication professionals, on the other scientists and researchers.

The Technical University of Munich is in charge of evaluating the NANO TO TOUCH activities. An overview of the methods used for the evaluation is provided in the final section of this brochure.

## / Ecsite [www.ecsite.eu](http://www.ecsite.eu)

Ecsite is the European network of science centres and museums, linking science communication professionals in 400 institutions in 50 countries. Founded 20 years ago, Ecsite connects member institutions through projects and activities and facilitates the exchange of ideas and best practice on current issues.

Members include science centres and museums, science festivals, natural history museums, zoos, aquariums, universities, research organisations and companies communicating and engaging the public in science through accessible, interactive exhibits and programmes.

### Photos :

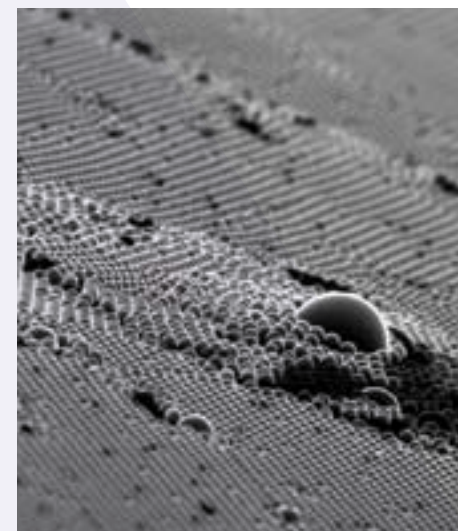
01 The Open Nano Lab in Deutsche Museum's Centre for New Technology.

02 Defect on a gold covered monolayer of polystyrene nanospheres with average diameter of 600 nm, University of Tartu.

01



02





## / Open Nano Lab

LOCATION : MUNICH, GERMANY

The Open Nano Lab in the Deutsches Museum is located in the Centre for New Technologies, a new exhibition focusing on nano- and biotechnologies. The context of research carried out in this lab is determined by the development of new fabrication strategies for materials science and nanotechnology. The research is focused on the generation and manipulation of organic semiconductor nanostructures on inorganic surfaces. The aim is to develop approaches which are suitable for ambient conditions (room temperature, air), thus having the potential of a widespread, economical applicability. For the research, four different Scanning Probe Microscopes and a fast computer for Molecular Modelling simulations are used. An average number of eight students at a time are recruited from the Munich universities, from interested visitors asking for internships, via job offers published on the research website, and via cooperations and student exchange programmes between the Open Lab and universities from Canada and India. In addition to the research, nano-demonstrations are given four days a week in a special section of the lab. Visitors are also continuously encouraged to ask questions and discuss.

**/ Deutsches Museum**  
[www.deutsches-museum.de](http://www.deutsches-museum.de)

With more than 47,000 square meters of exhibition space in the main building, 50 departments and approximately 1.3 million visitors per year, the Deutsches Museum is one of the biggest science and technology museums in the world. Its unique collection of historical and modern exhibits documents the evolution of technology and science from the early beginnings to the present day. Interactive experiments, dioramas, films and multi-media systems supplement the display. The Deutsches Museum created the concept of the Open Nano Lab and now coordinates the NANO TO TOUCH project.

**/ Technische Universität München**  
[www.tumuenchen.de](http://www.tumuenchen.de)

The Technische Universität München (TUM) is among the highest acclaimed universities in Germany and has produced several Nobel Laureates including Gerhard Ertl who received the Nobel Prize in Chemistry in 2007. TUM boasts a strong profile in science and engineering. Alongside the traditional key areas addressed by technical universities, powerful links have been also established with the life sciences, ranging from nutrition and food sciences, biotechnology and bioinformatics to medicine. The increasing importance of science communication was recognised by the establishment of a new faculty in 2009, the TUM School of Education.

**Photo :**

Live demonstration in Deutsches Museum's Open Nano Lab.



Nanopartikel  
Applications of nan



## / Open Nano Lab

LOCATION : MILAN, ITALY

The Open Nano Lab is the main element of the Nanotechnology Area in the New Frontiers Department. In the lab, CIMaINa researchers study the properties of nanostructured materials such as titanium dioxide and carbon. These nanomaterials have applications in different devices: for example in photovoltaic cells for producing electricity from sunlight, in supercapacitors that store electrical energy or in cells for the production or exploitation of hydrogen. Visitors have the opportunity to observe scientists at work, interact with them and discover the world of nanotechnology through nanoproducts, interactive exhibits, audiovisual facilities, science shows and educational activities. Visitors are invited to come to the museum and “disturb” the researchers, to understand what nanotechnology is and to express their points of view.

### / National Museum of Science and Technology Leonardo da Vinci

[www.museoscienza.org](http://www.museoscienza.org)

The Museum opened in 1953 and it is now the largest science and technology museum in Italy. Its mission is to disseminate scientific and technological culture, making it accessible to all. Collections and interactive laboratories are organised into: Materials, Transport, Energy, Communication, Leonardo – Art and Science, New Frontiers, Science for Young Children.

The museum is a place for sharing and dialogue where it is possible to experience an interactive lab, discover the greatest collection of models of machines realised from Leonardo da Vinci's drawings, explore the Toti submarine, participate in conferences and make up your mind on the latest scientific issues.

### / University of Milan CIMaINa

<http://users.unimi.it/cimaina/cimaina.html>

The Interdisciplinary Centre for Nanostructured Materials and Interfaces (CIMaINa) aims to develop a deep understanding of the phenomena governing the interaction between inorganic and organic surfaces at the nano- and microscale level. The centre merges competencies in material chemistry, solid-state physics, molecular biology and medicine, pharmacology, optical and electronic spectroscopy. The knowledge gained is exploited for a variety of applications including catalysis, optoelectronics, chemical sensing, biomaterials, drug delivery, polymer therapeutics, cell biology and postgenomics.

**Photo :**

Area dedicated to nanotechnology  
in the National Museum of Science and Technology.





## / Open Nano Lab

LOCATION : GOTHENBURG, SWEDEN

In Universeum, the nanolab is placed in an area focusing on nature, between the aquarium hall and the tropical rain forest. A terrarium has been positioned next to the nanolab with Madagascar geckos and a display explaining the nano technique they use to climb on all kinds of materials connects the nanotechnology in the lab with the nanotechnology in the natural world. For the same reason, lotus plants are grown in a pool next to the lab to show the lotus effect.

The laboratory consists of two lab units with a demonstration desk in between, where the researchers show different nano applications such as nano glass powder, ferrofluid and some nano products from the household. Scientists in the nanolab investigate the properties of the DNA molecule by stretching and extending DNA molecules and using them as building blocks. In order to see these extremely small molecules, two techniques are used in the nanolab. With fluorescence microscopy, DNA is labelled with a fluorescing dye and its movement in an electrical field can be followed in real time on a computer screen. In surface plasmon resonance, pieces of DNA are put together on a gold surface. How fast and how well the pieces fit together is measured in a in an optical process that measures the change of mass in time. By observing its behaviour, scientists learn how to handle DNA.

### / Universeum AB

[www.universeum.se](http://www.universeum.se)

Universeum is Sweden's largest science centre, with a huge variety of interactive displays wrapped up in a high-tech building engineered for the future with sophisticated energy and water recycling systems.

There are six main exhibition areas. The Water's Way recreates the greatly diverse Swedish landscape, from the high fells to the Baltic Sea. The Ocean Zone includes several aquariums, both tropical and temperate. Venomous animals from all over the world, such as cobras, rattlesnakes and mambas are found in the Deadly Beauties section. The Rainforest Zone houses tropical plants, birds, reptiles and amphibians at a balmy 28°C. The physical universe, from subatomic particles to whole galaxies, can be appreciated at a glance in the Kaleido Zone. Finally, the Explora Zone focuses on the theme of communication in all its aspects.

### / Chalmers Technical University

[www.chalmers.se](http://www.chalmers.se)

Chalmers is a Swedish university of technology that conducts research and teaching on a broad range of subjects related to technology, natural science and architecture. Our inspiration lies in the joy of discovery and the desire to learn. Underlying everything we do is a wish to contribute to sustainable development both in Sweden and world-wide.

#### Photo :

Researchers and visitors perform experiments with DNA molecules in Universeum's nanolab.





## / Researcher Live Area

MECHELEN, BELGIUM

The Nano Corner in Technopolis® has been especially designed for explaining the possibilities of nanotechnology. It consists of a work table, several cupboards, suspended glass cases and a flat screen. An eye-catching exhibit invites children to measure their height in nanometres. One of the cupboards contains a scanner that is used by the participating PhD students of the University of Antwerp to tell their story. Examples of nanoproducts that people use in their everyday life, enriched with short popular science texts, are displayed in glass cases. The central worktable on wheels is used by Technopolis® edutainers and PhD students to give demonstrations about nanotechnology.

Two kinds of activities take place in the Nano Corner. First of all, edutainers of Technopolis® give short demonstrations about nanotechnology, explaining for example memory metal, ferrofluids and magic sand. These demos show the science behind nanotechnology to different target groups (mainly children) in a fun and exciting way. Second, science PhD students provide in-depth information in a more personalised way for interested visitors. They make silver nanoparticles and explain the principles of 'nanoscopy' by scanning small objects with a special device, called a microtomograph.

**/ Technopolis,  
the Flemish Science Centre**  
[www.technopolis.be](http://www.technopolis.be)

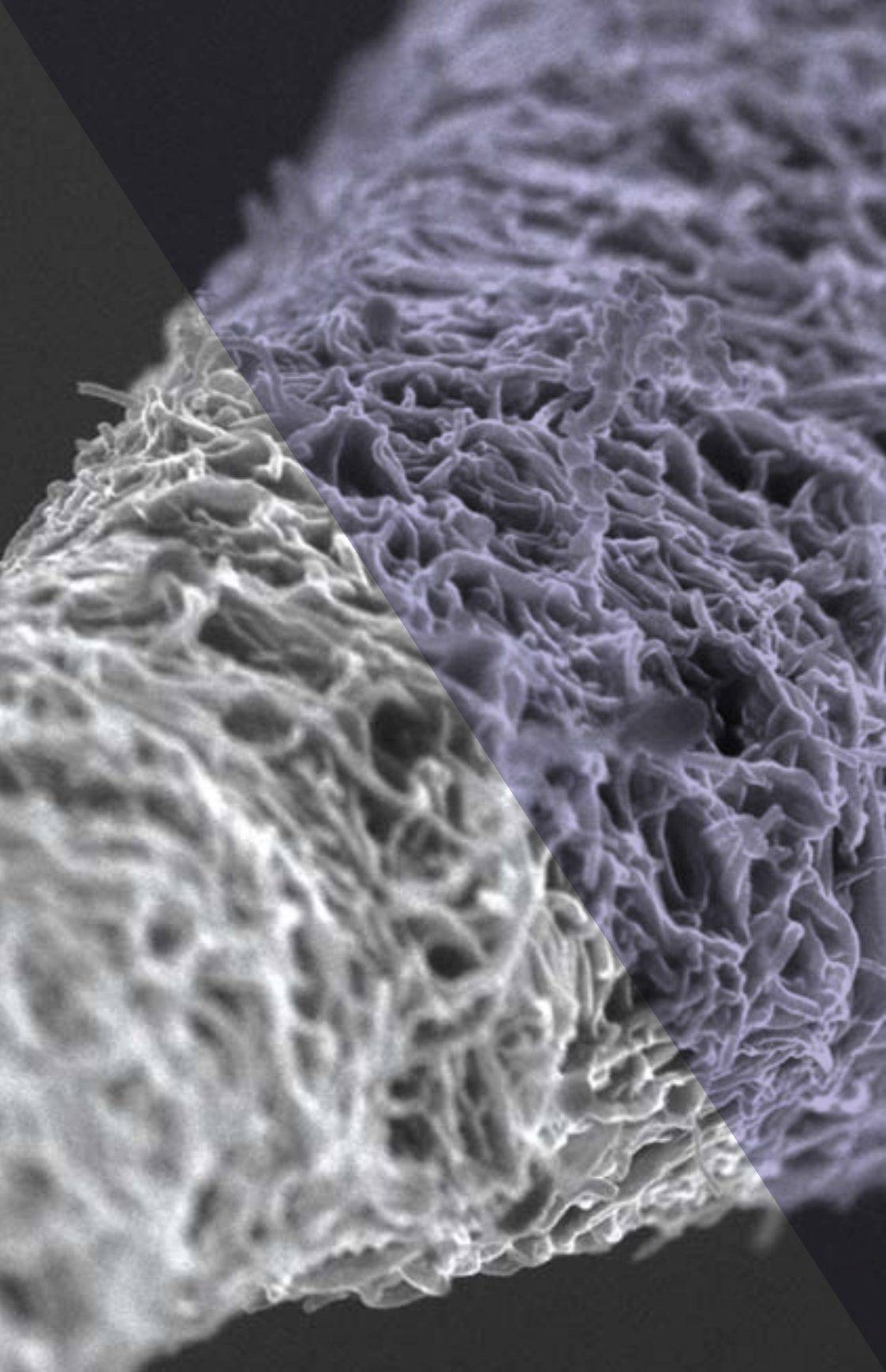
Technopolis® is the Flemish Science Centre, a place where people can experiment and find out the how and why of countless technological and scientific phenomena. Technopolis® is a permanent platform for science and technology that evolved from a non-profit organisation, the Flanders Technology International. Through the science centre in Mechelen and a wide range of other activities in Flanders, Technopolis® has been continually providing the communication of science with personality since February 26, 2000. Technopolis® has more than 300.000 visitors a year. The mission is clear: bringing science and technology closer to people, enhancing the public's engagement to science and technology. The exhibitions approach the science behind everyday things in an interactive manner, thus making even the most complex phenomena clear to a large audience. Next to this, Technopolis® also offers a wide range of outreach activities aimed at schools, public groups and other targeted audiences.

**/ Universiteit Antwerpen**  
[www.ua.ac.be](http://www.ua.ac.be)

The University of Antwerp (UA) is characterised by its high standards in education, internationally competitive research and entrepreneurial approach. The University of Antwerp has approximately 13.000 students, over 1.000 of which - exchange students not included - come from foreign countries, with a majority of EU countries.

**Photo :**  
An edutainer explains the properties  
of memory metal in the Nano Corner in Technopolis®.





## **/ Researcher Live Area**

TARTU, ESTONIA

A special NANORoom and dedicated exhibition is set up in the AHHAA centre. The exhibition shows examples of commercially available products that use nanotechnology, samples and research equipment and comprises microscopy photos made using SEM, TEM and AFM equipment as well as optical microscopes.

Many activities are organized for school and family publics on nanotechnology, such as Science Theater funny lectures and hands-on experiments on topics such as AFM model, ferrofluid, Aerosil and memory alloys. Twice a month, NANOweekends are held with lectures from scientists and students about cutting-edge research topics in nanotechnology. Groups from the AHHAA centre also visit the university open laboratory where they learn about the work of the scientists and the equipment they use.

Since the beginning of the NANO TO TOUCH project, nanosciences have enjoyed an enhanced media coverage in Estonia, where newspapers and TV chains have reported on the work of the Nanophysics Group.

### **/ AHHAA Science Centre at Tartu University**

[www.ahhaa.ee](http://www.ahhaa.ee)

AHHAA was established as a special project of the Department of Research and Institutional Development of Tartu University (founded in 1632). However, AHHAA has now made significant advances from the initial project, to become an independent contemporary science centre with cutting-edge science communication activities and displays.

### **/ University of Tartu Institute of Physics**

[www.fi.tartu.ee](http://www.fi.tartu.ee)

To realise the aims of the newly independent Estonia with regard to science and education, and to merge research and teaching effectively, the Institute was incorporated into the University of Tartu in 1997. Thus, the Institute has been rather dynamically reshaped according to the development of public demands and the development of the scientific atmosphere in the region. It is now a highly autonomous research establishment - the Institute of Physics, University of Tartu.



**Photo :**

A tungsten needle covered with multiwalled carbon nanofibres, University of Tartu.



## / Researcher Live Area

NAPLES, ITALY

Città della Scienza's Nano Research Area is located at the heart of the science centre. A compact exhibition introduces the visitor to the objects related to nanotechnologies that are already on the market. The public's experience is enhanced by frequent demonstrations and hands-on experiments run by the science centre explainers and by the students of the CNR research centre. Topics of these activities range from the concepts of "Nanoelectronics" and "Superconductivity", through to the most recent advances in nanotechnological applications for biomedical research. Demonstrations focus in particular on developmental neurobiology and on the structure, physiology and evolution of the nerve of Hydra, an elementary organism studied by the scientific partners in pollutants bio monitoring.

A special programme of scientific conferences is organised for visitors who want to keep in touch with cutting-edge research in nanosciences. Specific educational pathways about nanotechnologies are available for school groups visiting the science centre.

### **/ Fondazione IDIS Città della Scienza** [www.cittadellascienza.it](http://www.cittadellascienza.it)

The Fondazione IDIS-Città della Scienza is a non-profit organisation operating since 1987 which now plays a leading role in the dissemination of scientific knowledge and technological innovation.

The aim of the Foundation is to ensure a wide public involvement in science and technology, to engage people in an open dialogue and to establish a knowledge-based society with new improved job prospects and greater social cohesion.

Main fields of activity are the organisation of events and cultural activities on science communication and public understanding of science; international and national projects on science and society and citizens participation in science and technology, science education and informal learning.

### **/ Istituto di Cibernetica "E. Caianiello" - CNR**

<http://perseo.cib.na.cnr.it/cibcnr>

The Institute is part of the Italian National Council for Research (CNR). Its mission is to develop advanced technologies in the fields of condensed matter physics, ICT, neurosciences and life sciences.

The Institute is both active in highly specialized sectors and strongly oriented towards interdisciplinary cooperation.



**Photo :**

Element of the exhibition that introduces the visitor to nanotechnology in everyday life at Naples's Città della Scienza.

# / Evaluation



The Technical University of Munich (TUM) is in charge of the evaluation of the NANO TO TOUCH project activities. The work aims to evaluate the project's new ways of communicating research between scientists and the public in nanotechnology. The team will develop recommendations based on the results obtained from the quantitative and qualitative data collected.

The visitors' experience with the open labs and researcher live areas is evaluated through standardised surveys conducted in all countries. The investigation focuses on the public's image and impression of nanotechnology, on their interest in the subject and on what they feel they have learned from the visit to the open labs and research areas.

The impact of the project on the participating scientists is also assessed, both in terms of their work in the open labs/researcher live areas and of the usefulness of the workshops and trainings organised by the consortium. TUM investigates whether the researchers' ideas and perceptions concerning science communication have developed and changed as a result of their participation in the project.

Detailed insight into the crucial aspects of an open lab visit will be ensured through an intensive study with school classes and teachers in the Deutsches Museum. The study will deliver qualitative and quantitative data on cognitive and motivational aspects of the visit, focusing on topics such as the perceived increase of knowledge concerning the topics presented, interest, self-concept and ideas for improvement.

**Photo :**

Visitors to Milan's nanolab observe the researchers at work through the big glass windows provided.



The project is funded by the European Commission under the Seventh Framework Programme.



To learn more about the project :  
[www.nanototouch.eu](http://www.nanototouch.eu)  
or contact Paul Hix, Project Manager,  
Deutsches Museum :  
[p.hix@deutsches-museum.de](mailto:p.hix@deutsches-museum.de)

