# PhD@Empa. Your Chance!

## Information for graduate students

EMPA

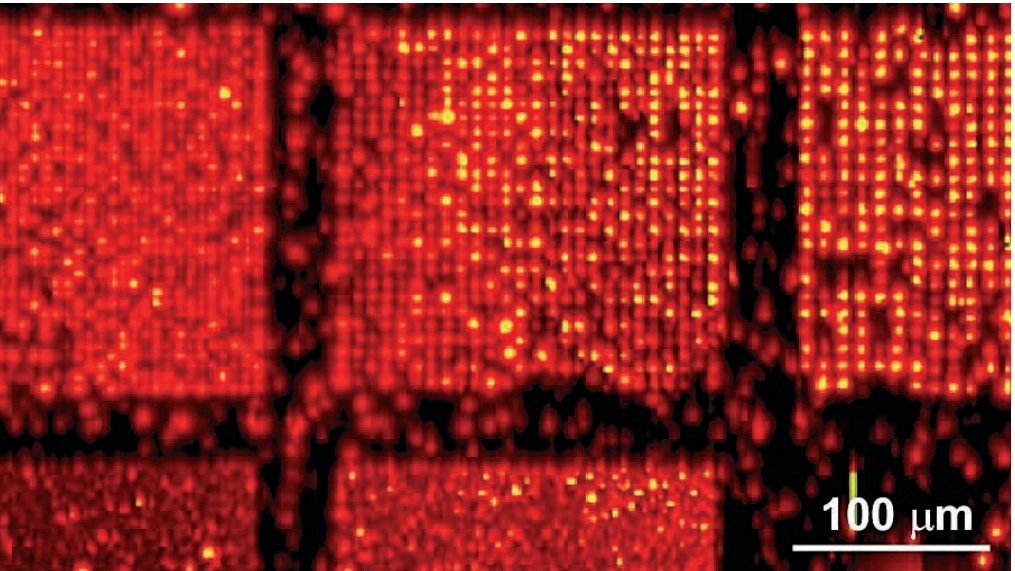
Materials Science & Technology

## You are…

- A student of natural sciences or engineering
- Interested in interdisciplinary questions in the field of materials science and technology
- Highly motivated
- Interested in collaborations with experts of various fields in science and industry

## Empa embodies…

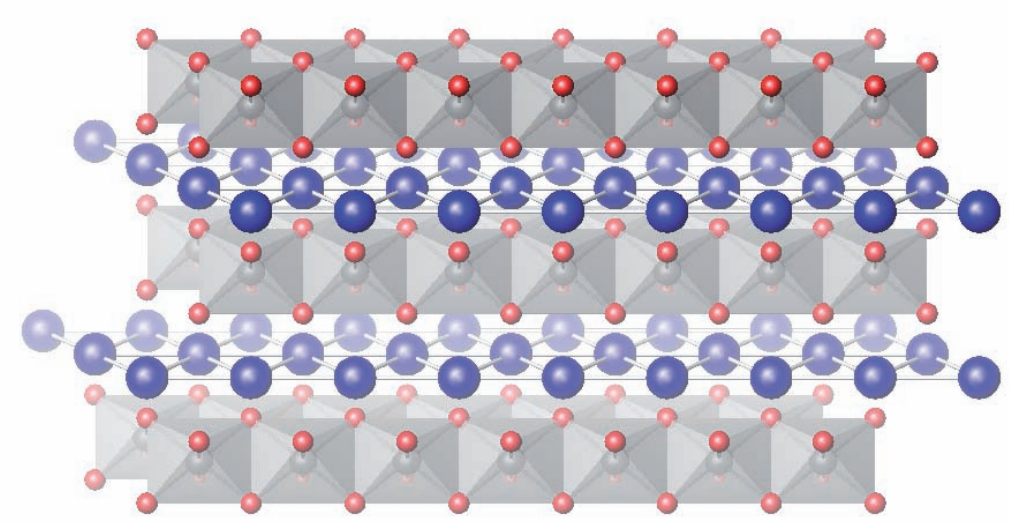
...Materials research and technology.



# Mission

- Empa generates knowledge relevant to society's needs at an internationally competitive level in the fields of advanced materials and environmental sciences and technologies, which it then transfers into practice.
- Empa addresses society's needs for sustainable materials and system technologies in the areas of mobility, communication, construction and engineering, health, air quality and energy.
- Empa's innovative activities in the fields of safety, reliability, and sustainability contribute to a better quality of life.
- Empa's strength lies in linking science and engineering, in interdisciplinary research based on long-term experience, and in the application of its knowledge to solve practical problems.
- Empa disseminates its expertise by vigorously supporting continuing education at an academic level.
- Empa tackles complex problems, offering the highest level of quality of service, reliability, and independence. Its neutral expertise provides the technical basis needed by legislative and executive authorities.
- Empa as a national institution is committed to solving the scientific and technical problems of public bodies which do not have laboratories of their own.

Empa. Materials research and technology.



# Research Programs

Our research programs show us in our true colors.
They define our areas of central research, and foster a spirit of interdisciplinary collaboration. We are currently intensively involved in five research programs:

- Nanotechnology
- Adaptive Material Systems
- Technosphere – Atmosphere
- Materials for Health and Performance
- Materials for Energy Technologies

## What are the questions we deal with in the area of Nanotechnology?

What novel functional capabilities can be achieved using tailor-made nanostructured materials and surfaces?

Where do the ultimate limits to the miniaturization of modern microelectronics using semiconductor manufacturing techniques lie?

Do supramolecular structures based on examples found in nature show the way forward to new solutions to the medical and biological challenges of the 21st century?

**Prof. Dr Hans Josef Hug**
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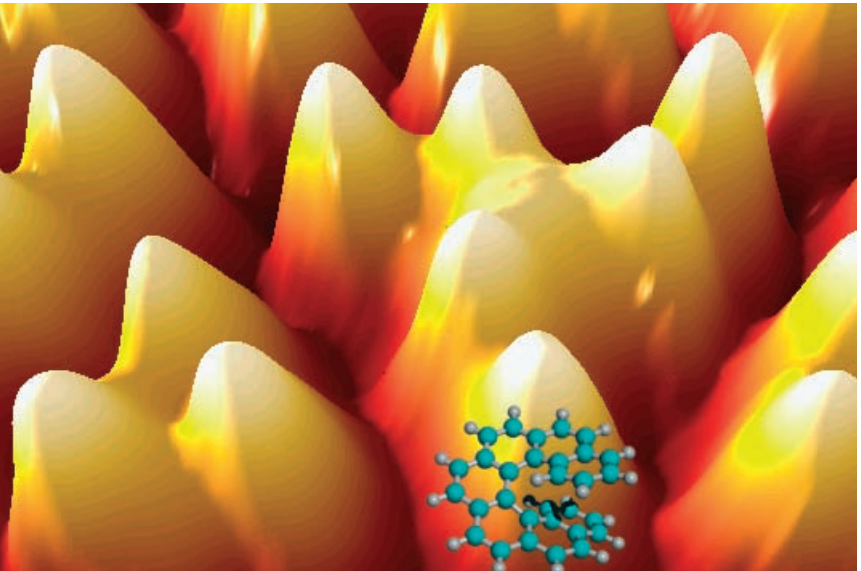
www.empa.ch > Nanotechnology

# Nanotechnology



Entry into the nanometer-scale world gives scientists access to the basic elements of our materials. This allows us to develop new materials with novel functional capabilities which can be used to solve existing problems. The Empa has established itself as a leading Swiss R&D institution in the field of nanotechnology, the applications-oriented exploitation of nanoscale effects. We can call upon our broad spectrum of interdisciplinary know-how in this scientific field which lies between physics, chemistry and biology. In collaborative projects we use our experience to develop promising new applications. For example we help uncover innovative solutions to problems in modern energy technology and are working together with the IT industry on novel concepts in micro and nanoelectronics. Other future-oriented projects are exploring the use of evolutionary construction principles found in nature.

## What are the questions we deal with in Adaptive Material Systems program?

Can we adapt biological behavior patterns for use in innovative material systems?

Which materials systems are suitable for being equipped with “intelligent capabilities”?

Which adaptive materials can be exploited for medical purposes?

as of July 1, 2006

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**Prof. Dr Edoardo Mazza**
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**www.empa.ch > Adaptive Material Systems**

# Adaptive Material Systems

The concept underpinning adaptive material systems is based on the behavior of biological systems which are capable of reacting in an intelligent way to changes in their environmental conditions. Using textile and fiber based composite materials for mechanical components on the macro scale and the integration of materials with the ability to act as sensors and actuators (which can be linked using adaptive controllers or neural networks), we are developing integrated mechanical systems and making them technologically exploitable. For example, we have developed a system which measures and actively suppresses oscillation in bridge structures. And ever since our actuators and systems reached the stage of development where they operate “on command”, more and more potential applications have presented themselves.

## What are the questions we deal with in Technosphere – Atmosphere program?

What are the principle sources of atmospheric pollution?

How can we reduce the amount of pollution in the atmosphere?

How can we meet our need for mobility in a sustainable manner?

What effects does the polluted atmosphere have on the materials we use?

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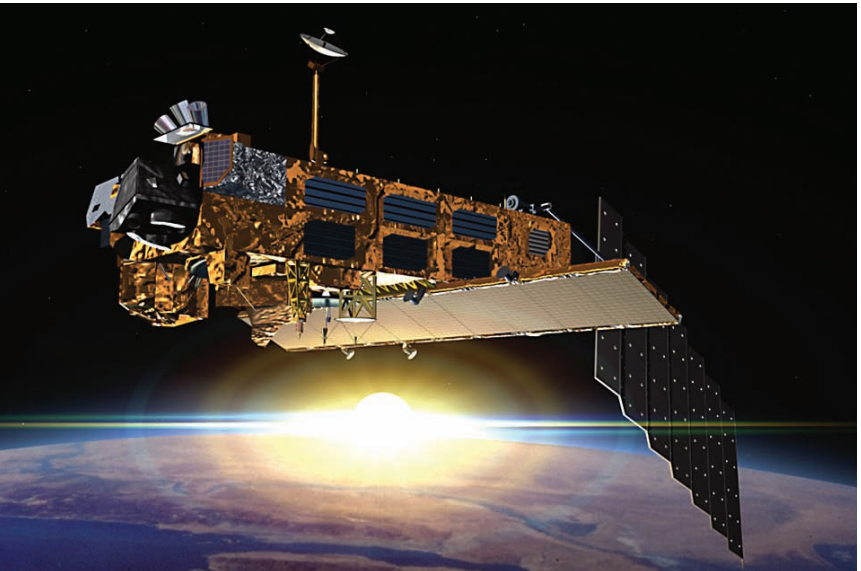
# Technosphere – Atmosphere



Many substances produced by man in the course of daily life in the technosphere find their way into the atmosphere. Depending on their composition, some act as greenhouse gases, influencing the earth's climate, some as toxins or particulates affecting our health, and others are responsible for undesirable phenomena such as acid rain and corrosion. To help reducing this anthropogenic air pollution, we are engaged in investigating the fundamental physical and chemical processes involved. A better understanding of these processes is leading to the development of appropriate, innovative solutions. For example, as part of the CLEVER project (Clean and Efficient Vehicle Research) we are studying, in cooperation with our industrial partners, ways to enhance the efficiency of the powertrain in natural gas fuelled vehicles, while simultaneously reducing tail-pipe emissions significantly.

## What are the questions we deal with on the subject of “health and performance”?

With what materials can we help contribute to keeping humans healthy or restoring them to good health?

What sort of products must be made available so as to improve the quality of life and security of older persons?

What combinations of materials will aid sporting performances to improve still further?

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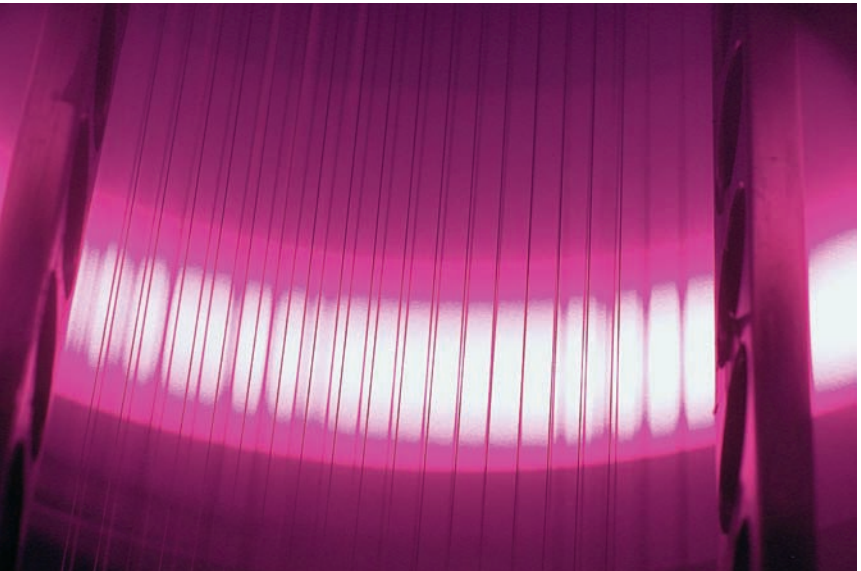
# Materials for Health and Performance



To protect people, to encourage good health in a sustainable manner, to maintain and improve our quality of life and physical capacity – these are topics which are becoming daily more significant in the light of continuously increasing life-expectancy trends. We have taken on this challenge, employing an enlightened combination of know-how and experience from the textile and material sciences, from biology and nanotechnology. The results are developments such as biodegradable implant materials, medical textiles and gerontological aids. Equally at the focus of or research activities are systems exploiting functional textiles, which not only support the thermoregulation of the human body but enhance personal wellbeing too.

## What are the questions we deal with in the Materials for Energy Technologies program?

How can materials research contribute to the development of new energy technologies?

What is the best way of creating efficient and reliable energy systems?

What effects do new energy technologies have on the environment, society and the economy?

**Dr Xaver Edelmann**
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# Materials for Energy Technologies


Today on average every Swiss person has a total primary energy consumption of about 6000 Watts, which is used for producing food and goods, for heating and cooling buildings, and for mobility. This lies well above the energy use limit set as the goal of the 2000 Watt Society, and bringing down this figure demands the implementation of new energy concepts and technologies. With a vision of reducing power consumption by two thirds, we are conducting research into advanced materials, processes and systems for the conversion, storage, and transport of energy. We are investigating ways to reduce conversion losses and to design more efficient energy systems, and we are researching ways of increasing the exploitation of renewable energies while minimizing the risks posed by these new technologies.

# The Academy

Keeping abreast of the rapid pace of technological progress in industry, the economy and society demands a broad overview of a wide range of research and development fields. The Academy is Empa's platform for knowledge transfer, used by our experts as a primary communication tool. Scientists and technologists use the Academy as a vehicle for dialog with the wider, non-specialists world.

The Academy has taken on the task of disseminating to a wider public the know-how gained in the course of our demanding research and painstaking investigations. It allows our clients open access to our greatest strengths – the width of our interdisciplinary experience, the depth of our scientific expertise, our continuity and our extensive network of national and international partners.

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EMPA AKADEMIE
*Zentrum für Wissenstransfer*

www.empa-akademie.ch

The Empa Academy organizes seminars, course, and lecture series in addition to its publications. Aside form the high-level technical and scientific events, it also offers special courses tailored to the further education and training of scientific staff.

Particular emphasis is placed on knowledge transfer from the field of nanotechnology to SMEs, and for this reason we created the “Mobile Academy”. Its aim is to demonstrate, during visits to the companies involved, the advantages which the correct use of nanotechnology can offer in terms of improvements to new materials.

# International PhD School Switzerland – Poland



WARSAW UNIVERSITY OF TECHNOLOGY

AKADEMIA GÓRNICZO-HUTNICZA IM. STANISŁAWA STASZICA RDK ZAŁOŻENIA 1919

EMPA

Materials Science & Technology

# The role of this binational PhD School

The PhD School is headed by Dr Jolanta Janczak-Rusch and specifically promotes interdisciplinary and multidisciplinary doctoral research projects. The topics are all at the interface between materials science, engineering science, physics, chemistry and mechatronics.

In addition to project-oriented teaching courses, a range of workshops and international conferences in Poland and Switzerland will be available to the students. Since the International PhD School will also be teaching «soft skills», the students will have the opportunity to acquire knowledge outside their own specialist field. For example, the Empa Academy will hold a two-week summer school on the subjects of «Basics of Management» and «Intercultural and Interdisciplinary Communication» in July 2006.

The Steering Committee (Prof. Krzysztof Sikorski, Prof. Jerzy Lis, Prof. Louis Schlapbach and Paul W. Gilgen) join the head of the International PhD School, Dr Jolanta Janczak-Rusch, in wishing the students an exciting and successful journey of discovery – true to the Empa motto «Research that inspires»!

**Dr Jolanta Janczak-Rusch**
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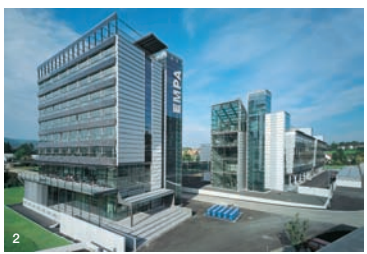
# 3 sites



**1** Dubendorf

**2** St. Gallen

**3** Thun

# Facts

**830** scientific, technical and administrative staff
(720 full-time positions)
**300** conference contributions and reports
**270** peer-reviewed (SCI/E) publications
**110** seminars, lectures and conferences held at the Empa Academy
**130** PhD students
**100** undergraduate students doing final year projects
**80** student trainees and apprentices
**83** million CHF in federal funding
**33** million CHF in third-party funding (incl. services)
**6** departments with 34 laboratories resp. sections
**5** interdisciplinary research programs
**3** sites
**1** Empa

Source: Annual Report 2005 Reading per January 1, 2006 Period of reference: 1 year

# Chronology

In 1880 the “Institution for the Testing of Building Materials”, the forerunner to Empa, begins its work. Its first Director is Dr Ludwig von Tetmajer, Professor of Building Materials.
The Institution is located at the Polytechnic in Zurich.

In 1891, Tetmajer is given the task of investigating the collapse of a railway bridge near Muenchenstein, built by the world-famous engineer Gustav Eiffel. Tetmajer is quickly able to demonstrate that the use of Euler’s hyperbola, which up to that time had been the standard technique, is only applicable in the elastic region of the steel used for the bridge.

In 1895 the name “Federal Materials Testing Institute” is first used, the German acronym for which is “Empa”.

In 1937 the Swiss Testing Institution, St.Gallen, having been expanded in 1911 to a textile testing authority, merges with Empa. The expanded organization is renamed the “Federal Material Testing and Experimental Institute for Industry, Civil Engineering and Trade”.

In 1962 the Empa moves from Zurich to Dubendorf. The key areas at this site are civil engineering, safety technology, surface technology, metallic materials, composites, non-destructive testing, chemical analysis, exhaust gas and atmospheric measurements, building technologies, building physics, acoustics and noise abatement.

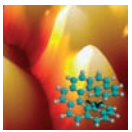
# Chronology

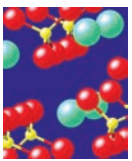
In 1988 a significant change of course occurs, with increased emphasis placed on research. The Empa is renamed “Federal Material Testing and **Research** Institute”. The research strategy is guided by a newly established Research Commission.

In 1994 the staff of the Armaments Services Group in Thun joins Empa and establishes the Materials Technology Laboratory. Core activities, which will be expanded over the decade, are tailor-made, application-specific materials and innovative technological developments.

In 1996, staff at Empa’s St.Gallen site move into their new building “Im Moos”. Core activities are clothing physiology, personal protective systems, functional fibers and textiles, biocompatible materials, materials and image modeling, and technology risk evaluation.

In 2001 Empa’s priorities are oriented even more firmly towards research and innovative development. Knowledge transfer and demanding scientific/technical services remain however an important part of the Empa portfolio. The organization is restructured into research departments, research programs are initiated and an international Research Commission established.





# Chronology

In 2003 Empa strengthens its research efforts in the field of nanotechnology. The new nanotech@surfaces Laboratory in Thun conducts research into nanostructures, nanotubes as electron sources and quasi-crystalline layers. The Functional Polymers laboratory is established in Dubendorf.

In 2004 yet another Laboratory, Nanoscale Materials Science, is set up in Dubendorf. It focuses on the development and analysis of nanostructured surfaces and coatings.

In 2005 the Empa celebrates its 125th Anniversary in the presence of Federal Councillor Pascal Couchepin. On the Open Day some 13 000 guests take the opportunity to pay the Empa a visit. Guests and media representatives alike are impressed by the wide range of research and other activities covered by the still-young institution.

research that inspires 125 years of Empa

In the jubilee year, too, the Empa's research fields and other operational areas will continue to be redefined with existing laboratories restructured and renamed, and new ones being established. Names such as Materials and Engineering, Mechanics for Modelling and Simulation, Materials-Biology Interactions, Biomaterials, Knowledge Management and Technology Transfer, and hydrogen@empa clearly reflect this metamorphosis, which began in 2001.

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Materials Science & Technology

# Empa. Materials research and technology.

Empa, a multidisciplinary research institute for materials science, engineering and technology within the ETH-Domain, is an established player in the Swiss national science, education and innovation landscape. Our core activity is the creation and transfer of knowledge. We specialize in applications-oriented research and development, as well as in offering our services to help solve demanding problems in the fields of sustainable materials science and technology. We create innovative solutions to meet society's requirements in the areas of mobility, communication, construction and engineering, health, air quality and energy. Sustainability and safety are ubiquitous themes which we address in an interdisciplinary manner across all our work.

Empa. Materials research and technology.

# What Empa offers

- PhD formation in specific areas of materials science, engineering and technology with a focus on application and transfer
- Experience in self-dependent project leadership
- Profound knowledge in materials science and interdisciplinary R+D work
- Good prospects on the job market
- Valuable contacts to research and industry
- Training in state-of-the-art scientific equipment
- Daily contact with numerous experts covering several disciplines within our five research programs
- A PhD Program that broadens your skills in science as well as your soft skills in order to advance your career

Further information:
www.empa.ch/PhD

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