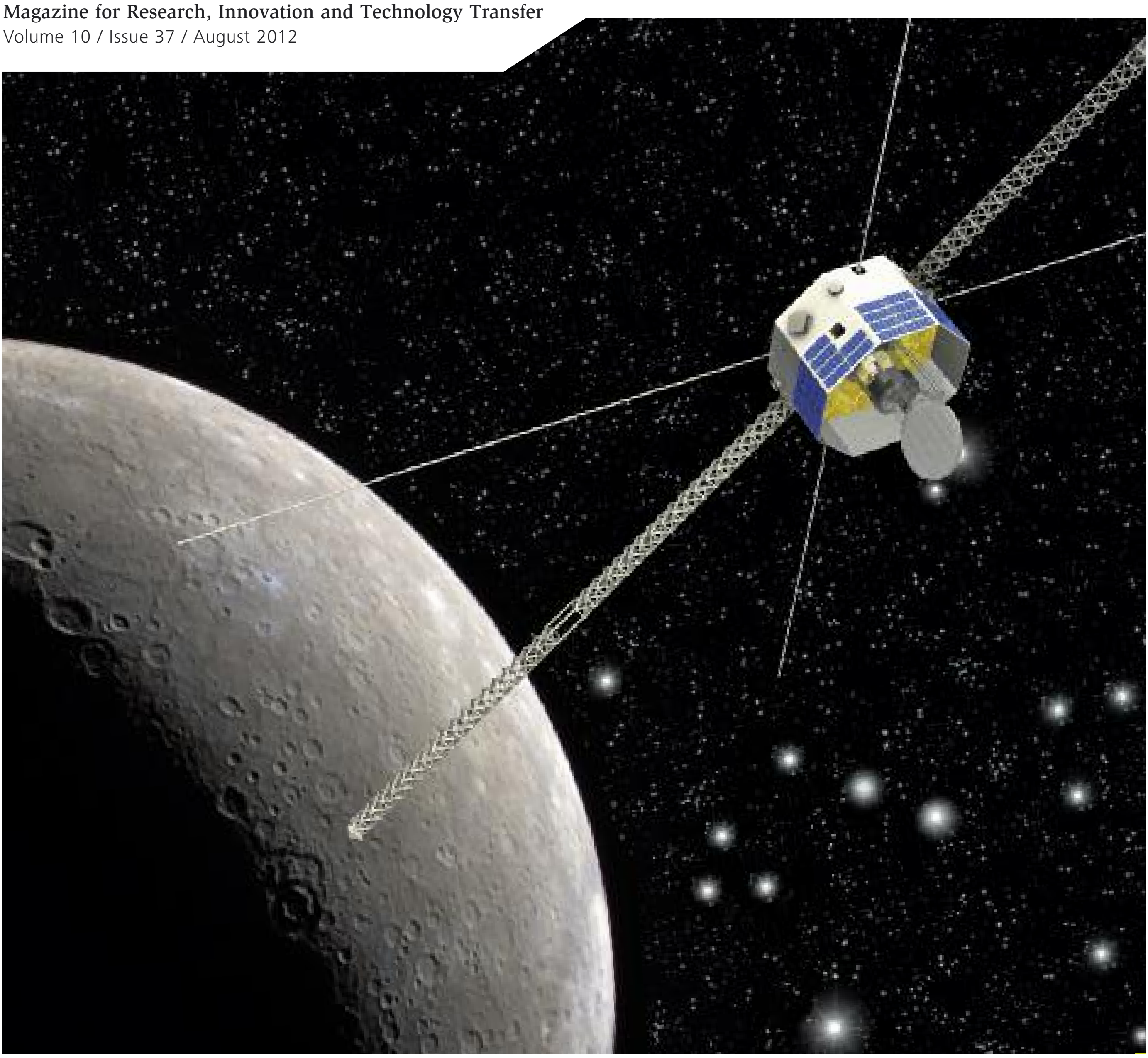
EmpaNews

Magazine for Research, Innovation and Technology Transfer
Volume 10 / Issue 37 / August 2012



Empa goes to space

EMPA Materials Science & Technology

At ease in all dimensions

CERN researchers recently obtained the first hints of the elusive Higgs particle in the "Large Hadron Collider"; around the same time Nasa was spreading breathtaking panoramic pictures from Mars, taken by the "Mars Exploration Rover". Two breakthroughs from opposite ends of scientific research, as it were: the unimaginably small in the case of the elementary particle, and the staggeringly large, i.e. our universe.

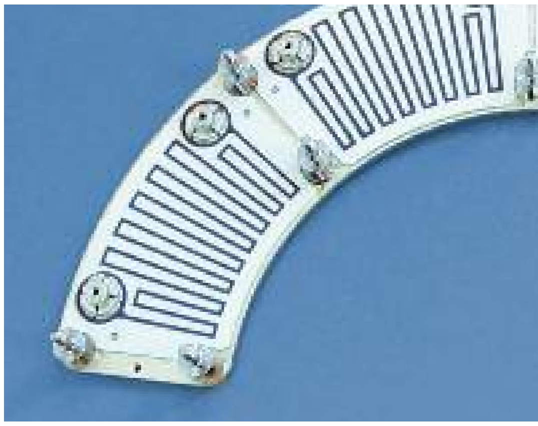
Empa is also working in both dimensions in applied research. For instance, Empa technology can be found aboard the "comet chaser" Rosetta, an ESA satellite that will be reaching its destination, the comet 67P/Churyumov-Gerasimenko, in 2014. The BepiColombo Mercury mission, which is due to take off in 2015 and research the innermost planet of our solar system, also has "Empa inside" (see page 4).

The other "end", i.e. the micro- or nanometer range, is important for, among other things, the development of innovative products in medical technology. In the current "Focus" we will introduce you to several examples from our laboratories – just in time for the inaugural "World Medtech Forum" in Lucerne in late September, for which Empa is acting as "Innovation Partner". To name but one example, the institute will be exhibiting new microstructured implant surfaces, which ensure that cells "feel at home" on the implant, grow better and thus hold on tight to it.

Our MedTech activities also exemplify how closely we work together with partners from industry in order to ultimately turn our research results into marketable innovations – including the motivational "friction" that occurs when inquisitive researchers eager for knowledge collaborate with developing engineers from industry who are geared to achieving commercial success (see interview with Synthes CTO Robert Frigg on page 18).

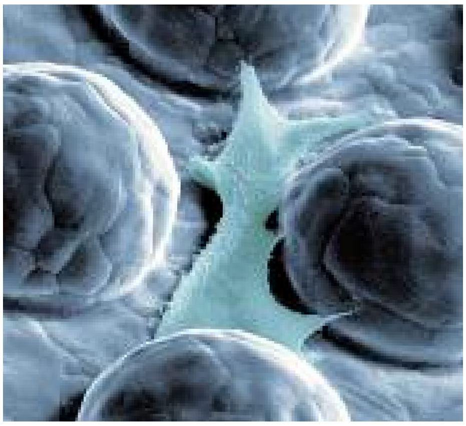
Enjoy reading!

Michael Hagmann
Head Communications



Cover

Starting in 2022, the Mercury Magnetospheric Orbiter (MMO) will orbit Mercury for a year. On board: an especially lightweight mass spectrometer whose heatable ionization unit was fabricated at Empa.



Imprint

Publisher
Empa
Überlandstrasse 129
CH-8600 Dübendorf
Switzerland
www.empa.ch

Text & Design
Communication

Contact
Phone +41 58 765 47 33
empanews@empa.ch
www.empanews.ch

Published quarterly

ISSN 1662-7768

Off to Mercury!

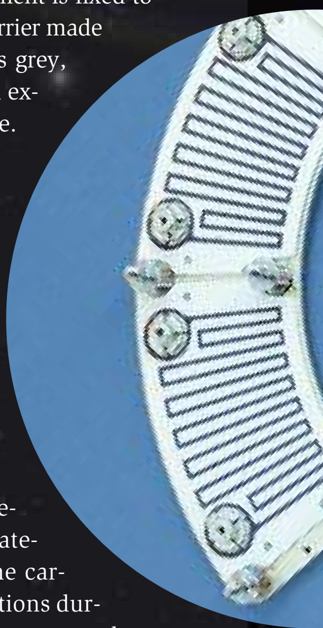
When the BepiColombo mission takes off for Mercury, Empa components will be on board the satellite. The specially soldered components of a mass spectrometer will withstand the chilling journey through space as well as the baking temperatures when orbiting Mercury.

TEXT: Rainer Klose / PICTURES: Empa, ESA

When an Ariane 5 rocket takes off in August 2015 to transport the "BepiColombo" probe of the "European Space Agency" (ESA) to Mercury, it will be equipped with know-how and precision work of an Empa laboratory: The ionisation equipment of a mass spectrometer, resistant to heat and cold, yet extremely light and reliable, was manufactured by Hans Rudolf Elsener, an expert for joining technologies. The probe will orbit Mercury for two years and analyse traces of chemical substances from a height of 400 kilometres, which should give researchers an indication of how the inner planets of our solar system were formed.

It's going to be a real temperature roller-coaster. The measuring instrument must withstand temperatures of down to minus 150 degrees C during the seven-year trip to Mercury. Once it arrives in orbit, the satellite will then be "grilled" by the sun. The temperature inside the detector will then rise to more than 300 degrees C. The Physical Institute of the University of Berne approached Elsener to help with the manufacture of a heatable component. As well as the temperature difference, weight also plays a decisive role on interplanetary missions. The "Mercury Magnetospheric Orbiter" (MMO) probe carries the instruments for five different experiments – but it must not weigh more than 45 kilograms.

Elsener and his team were to construct a semicircular, electrically heated support structure, which is needed to efficiently ionise neutral particles flying around in space. These ions are generated at coated conversion surfaces at the entrance aperture of the mass spectrometer, and pulled in by an electrical field. Periodic heating of these surfaces removes organic residues and improves the efficiency of the mass spectrometer. The entire surface of the aluminium oxide heating element is fixed to a stable metal carrier. Theoretically, a carrier made from niobium would be ideal, since this grey, shiny ductile metal has a similar thermal expansion coefficient to aluminium oxide. However, niobium is too heavy for the probe. Elsener and his team therefore decided to use a carrier made from titanium, which was half the weight. The entire component now weighs no more than 40 grams.

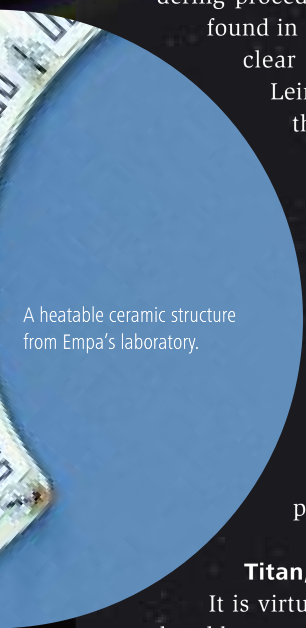


The art of soldering

But the use of titanium also entailed some problems: It expands much more than aluminium oxide when heated. The heating element must therefore be soldered on using a suitable material, so that it does not detach from the carrier because of the temperature fluctuations during the trip. At the same time, the temperature during the soldering process must not be too high – otherwise destructive tension occurs in the material combination, already at the manufacturing stage.

The "BepiColombo" space probe's trip to Mercury will take years. The instrumentation must be as light as possible and withstand extreme heat and cold. Hans Rudolf Elsener developed the soldering technology for a particularly sensitive component, which is made of ceramic and metal.

Soldering is the only way of connecting different metals to each other if strength, good heat transmission and heat resistance are required. And the wealth of know-how about soldering procedures that is available at Empa is rarely found in Switzerland, if anywhere. It was quickly clear to Elsener and his colleague Christian Leinenbach that they would not get far with the usual methods, which are mainly used in mechanical engineering. After analysing different substance groups, they homed in on an alloy made from gold and germanium. The solder melts at about 360 degrees C and, after hardening, is less brittle than an alloy made from gold and silicon, for example. The disadvantage: The exotic material is hard to find. Hans Rudolf Elsener had to have a 25 micrometer-thick foil tailor-made by a supplier in the USA.



A heatable ceramic structure from Empa's laboratory.

Titan, Tungsten, Gold

It is virtually impossible for a layman to comprehend how complex the soldering process is, even with a suitable solder. It requires a number of additional layers to make a perfect connection: A layer made from chromium-nickel, followed by a layer of titanium-wolfram and a thin layer of pure gold is needed to prepare the aluminium oxide. Likewise, the titanium carrier is coated with nickel and gold. In order to improve adhesion the layers must be baked onto the subsurface in a vacuum furnace at 500 degrees C (tempered, as the experts say). Only then can the gold-germanium solder firmly connect the components. The Empa experts discovered the perfect combination of all methods using shear tests with small test objects. First a prototype of the component was manufactured and subjected to both vibration and thermocyclic tests. It passed the tests without any problems whatsoever. Elsener and Leinenbach then manufactured "the real thing" – a flying model to go on the satellite and a substitute.

A long, long journey

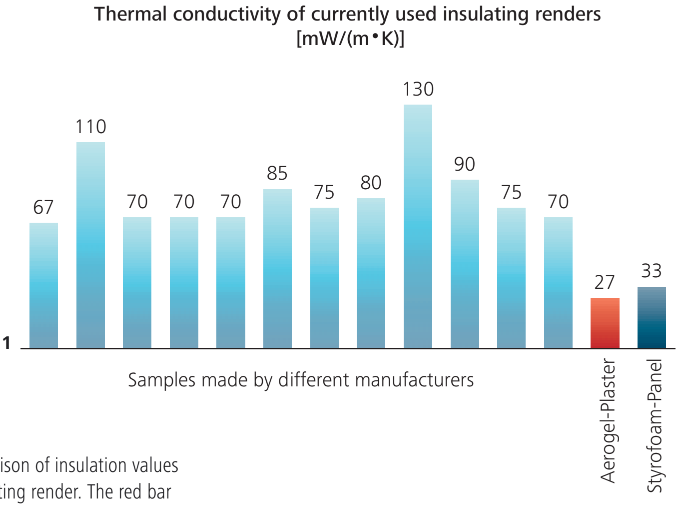
The BepiColombo satellite mission, named after an Italian mathematician and space pioneer, consists of three segments: a European and a Japanese orbiter and an ESA drive module, which transports the two probes to Mercury. The entire unit will be six metres high and will weigh about four tons – about one-third of which is fuel. The Empa component will fly in the Japanese satellite. The space probe will reach Mercury in January 2022, send the two orbiters into orbit around the planet and radio information to Earth. If everything goes as planned, we will know more about the surface chemistry, the core and the magnetic field of Mercury – and also a little bit more about the history of the creation of our solar system. //

2

Space technology for old buildings

Old buildings are beautiful – and hard to insulate. Empa has developed a new Aerogel-based plaster that provides twice the insulation of currently used insulating renders. The product should come onto the market next year.

TEXT: Rainer Klose / PICTURES: Joachim Kohler; Fixit / ILLUSTRATION: Empa



1
A comparison of insulation values for insulating render. The red bar refers to the Aerogel render: it has insulation values similar to those of polystyrene panels (blue).

2
A historic timber-framed house in Kreuzlingen: those who would like to insulate the building's walls without marring its visual appearance often are not able to turn to insulating panels. Insulating render is the solution.

3
A sample of the Aerogel render is sprayed on with a professional rendering machine and then smoothed out. In the next step, the soft render will have to be protected with a tough surface layer.

There are one and a half million old buildings in Switzerland. We have to live with these buildings – indeed we want to live with them. Yet at the same time the country's energy consumption is increasing. According to the Federal Office of Energy, 4.5 million tonnes of light fuel oil and 3 million cubic metres of natural gas are imported every year, 43 percent of which goes up the chimney for heating. Anyone who wishes to cut down on fossil fuels must therefore insulate their home. But how do I insulate my historical building – be it a timber-framed house in Thurgau, a town house in Solothurn or an art-deco apartment building in the north of Zurich? Heritage protection would be none too pleased if the historical façade was simply boarded with modern insulating panels.

Rendering is the most suitable way of maintaining the look of an old house. Cutting insulating panels to size (and shape) is also a cumbersome business when lining winding staircases, round arches and supporting walls. “An inner lining of insulating render is considerably quicker to apply,” says Empa building physicist Thomas Stahl. “The render also lies directly on the brickwork and does not leave gaps where moisture could condense.”

Stahl has made it his task to take the insulating properties of render to a new level, and to develop a render that provides as much insulation as a polystyrene board. Years of research have now finally paid off: The product, which

3

Video:
Aerogel render is being applied

http://youtu.be/5zf_mj3L6Y8
For smartphone users: scan the QR code (e.g with the “scanlife” app)

has been developed jointly with Swiss render manufacturer Fixit, has come through laboratory testing, and initial trials on buildings started in July 2012. According to Fixit, if the new insulating render holds up to its promise, the material could come onto the market in the course of next year.

World record for insulators

But what does this marvellous render from the Empa labs consist of? Stahl and his colleagues decided on the best insulating material that can be produced industrially: aerogel. The material, which is known as frozen smoke” because of its appearance, consists of around 5 percent silicon – the rest is air. Aerogel was used back in the 1960s for insulating space suits, and has 15 entries in the Guinness Book of Records, including “best insulator” and “lightest solid”.

Aerogel is already being used in the building industry, as cavity-injected wall insulation or in the form of insulating boards made from fibrous fabrics. So where is the problem? Why hasn't anybody already mixed aerogel with render? Thomas Stahl doesn't waste his breath on a lengthy explanation. He takes a transparent plastic box off the shelf and opens the lid: “Put your hand in and rub it a little.” The aerogel globules really are extremely light, almost weightless, and can be held between thumb and forefinger. But as soon as you rub your fingers, it crumbles. After two or three rubs, a fine powder is all that remains of the wonder material. “And that was precisely our problem”, says Stahl, “if we mix the powder with water and apply the render by hand, the results are good. But imagine if the render was blown through the hose of a professional rendering machine at a pressure of 7 to 8 bar. There wouldn't be much left of our aerogel.”

In order to make the render “machine-compatible”, a tremendous amount of knowledge about the contents of dry render mixtures and their interactions with aerogel was required. And a series of tests – from palm-sized laboratory samples to weathering tests lasting for months. Eventually Stahl found a solution, which he now wants to have patented.

The samples of the aerogel render exhibited a heat conductivity of less than 30 mW/(mK) – twice as much insulation as the insulating render that is currently commercially available (see bar diagram on left). If the innovation asserts itself on the market, Swiss house owners will soon see a considerable reduction in fuel consumption. //

1

2

On the road – with hydrogen

TEXT: Martina Peter / PICTURES: Empa

At the end of May, two vehicles and a portable living and working module got together in front of the Empa premises in St. Gallen: the "hy.muve" street sweeper, a fuel cell-driven bus and the "Self" container. They all have one thing in common: the use of hydrogen as an energy source. Both street sweeper and bus use it as fuel, and "Self" uses its own "hydrogen plant" to generate (and store) energy in summer, which can later on be used for cooking and heating.

"hy.muve" is clean, makes clean

The "Bucher Schörling CityCat H2" hydrogen-powered street sweeper that was developed by Empa in collaboration with PSI and industrial partners, had been tested on the streets of Basel for three years. The advantage: It emits only water vapour as exhaust and is extremely quiet. In April 2012 the system and the vehicle were relocated to St. Gallen for another real-world assessment. Here it will be all about testing the municipal vehicle, which has by now overcome its teething troubles, in everyday use, gaining more experience in the use of the vehicle and examining the ageing behaviour of the different components.

3

1
A bus with a fuel-cell drive sits proudly in front of the glass-encased Empa building in St. Gallen. Empa offers its expertise to advise local authorities and cantons in the planning of a new hydrogen infrastructure.

2
The "hy.muve" hydrogen-driven road sweeper developed at Empa has already been tested in Basel and is currently cleaning the streets in St. Gallen. Additional Swiss cities will follow.

3
Self-sufficient "Self" room module: The living and working container generates and stores the energy for its inhabitants, year round.

Bus saves energy and protects the environment

Five busses powered by fuel cells are currently being operated in Brugg in the canton of Aargau. Postauto Schweiz AG also recently opened a hydrogen filling station. PSI and Empa are on board as research partners. Empa's role during the testing phase is primarily of an advisory nature. Empa scientists examine the efficiency of hydrogen production, its incorporation in the electricity market and gathers experience in the construction of hydrogen filling stations for future projects.

Independent living and working in "Self"

"Self", a modern room module for living and working that is independent of energy and water, was also available for inspection in St. Gallen. Hot meals are prepared on a hydrogen-powered kitchen unit. Hydrogen is produced via electrolysis of water, and the electrical energy for this is generated using solar cells on the roof. Until the hydrogen is needed it is temporarily stored in containers filled with metal hydrides, another new development from Empa. Empa and Eawag are testing new building concepts as well as energy and water management technologies in "Self": very little complies with the current state of technology; almost everything consists of specially designed and conceived components, such as the building shell. //

Video:
A hydrogen powered bus

http://youtu.be/Xo6qCvkNyq0
For smartphone users: scan the QR code (e.g with the "scanlife" app)

Friendly implants

Cell biologists at Empa want to "tune" implants such that they can better carry out their tasks in the human body. The surface of the implant is the key to success. Together with the Fraunhofer Institute IFAM, the Empa team developed a method to manufacture implants with the required surface "from a single cast".

TEXT: Martina Peter / PICTURES: Empa, Synthes

In order to encourage the human body to accept an implant, its surface should be readily inhabitable by (future) neighbouring cells. Osteoblasts, i.e. cells that are responsible for bone formation, must be able to attach to an artificial hip joint so that new bone substance forms, thereby firmly anchoring the implant in the bone. Researchers at Empa are working to develop micro-structured implant surfaces that provide the bone cells with the best possible growth conditions. Arie Bruinink, cell biologist in the "Materials-Biology Interactions" laboratory, explains: "Amongst other things, we have seen that a surface structure with near cell-sized dimples has a considerable effect on cell shape and adhesion."

The scientists can observe how cells respond to different model surfaces with a confocal laser scanning microscope, amongst other things. Once the bone marrow cells had been disseminated onto a metal probe with a dimpled surface, they adhered to the material, formed their cell skeleton or cytoskeleton, and adapted their shape to the surface structure. On a surface with dimples with a diameter of 30 or 50 micrometres and 20 micrometres apart, the cells stretch between the dimples and are no longer as flat as they normally appear in a culture dish. Bruinink believes that this is a very conspicuous behaviour, the effects of which on cell differentiation should be investigated further.

Pore-free cleanliness – and still favourable

In order to manufacture implants in innovative ways, he initially developed a metal injection moulding (MIM) procedure with colleagues from the Fraunhofer Institute for Manufacturing Technology and Applied Material Research (IFAM) in Bremen. This allows the implant and its microstructured, biocompatible surfaces, to be

>>

>>

1
Empa researchers Arie Bruinink and Magdalena Obarzanek-Fojt in the lab looking at a computer screen to examine how well the cells have populated the test object's surface – and which surface structures favour cell growth.

2
One of the test objects with a microscopically fine dimpled surface.

3
This is how cells adhere to the structured surface.

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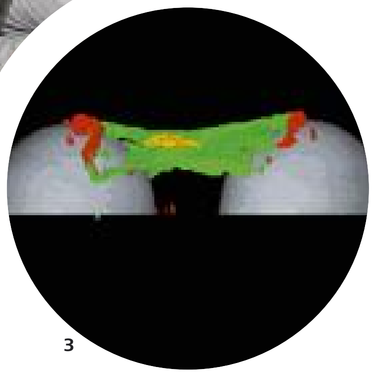

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manufactured in "a single cast". According to Bruinink, the aim of the project, financed by the Volkswagen Foundation, is to create surfaces that can be structured with (sub)micrometer accuracy – a precision that has hardly been possible to date; it takes a considerable amount of money and effort to manufacture structures like this. During implant manufacture it is also important that no unwanted pores form on the surface, in which germs could hide. These can cause infections and chronic inflammation – with the possible consequence that the implant will have to be removed again. Bruinink is pleased with the new MIM method, since it has succeeded in creating a precisely structured, pore-free surface simply and cost-effectively.

A patented method – and not just for the medtech sector

This method, which has now been patented, is not only suitable for materials in the medtech sector. The material's outstanding mechanical properties (high density and nanostructured design) are also interesting for other applications. The method could therefore be used in almost any situation where materials with greater strength and hardness are required, such as gears and ship propellers.

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Publication

M. Bitar, V. Friederici, P. Imgrund, C. Brose, A. Bruinink: In vitro bioactivity of micro metal injection moulded stainless steel with defined surface features, in: European Cells and Materials, Vol 23, May 2012 (pages 333-347)
http://www.ecmjournal.org/journal/papers/vol023/pdf/v023a26.pdf

Video:
Cell biologists discuss their work

http://youtu.be/sjERN3PLFWI
For smartphone users: scan the QR code (e.g with the "scanlife" app)

Medtech@Empa

TEXT: Harald F. Krug, Empa Board Member / PICTURE: Empa

> "Medtech materials should adapt to our body in an ideal way – without having any adverse effect."

Medical technology has been one of Empa's main research areas for more than 10 years. For a materials research institute such as Empa, the main focus is on the contacts and interactions between man and natural and artificial materials; more and more of these substances and particles are impinging on or even being implanted in our bodies. The demand for applications on and in the human body is a particular challenge for the area of materials development. It is not just a case of making materials resistant and long-lasting, that's a sine qua non; they must also be bio-compatible, i.e. compatible with the human organism, and should adapt to the conditions in our body in an ideal way – without having any adverse effect.

Empa develops materials for "spare parts" that fulfil current requirements of our society, which, on the one hand, is becoming increasingly older; on the other hand, many new sporting and leisure activities (some of which are quite dangerous) are leading to increasing numbers of younger patients. This means that a significantly longer service life is required (durability, corrosion reduction), a better integration (interaction with the organism and the surrounding tissue) and new ways of manufacturing and treating the implant surfaces (functionalisation, coating). Testing in biological systems is also part of the development of these materials, so that biological compatibility can be guaranteed.

Empa investigates these topics in its laboratories. The intensity, with which we do this, is shown by one simple figure: nine of the 29 research labs are involved in medical technology in the broadest sense. The Empa researchers go about their work in an extremely collaborative fashion, since the problems that occur when materials are installed in the human body or used directly on the human body can only be solved using interdisciplinary cooperations. Engineers, physicists and chemists, but also biologists, materials scientists and experts from other disciplines are involved in order to examine the problems in an integrated way, so that as many aspects of materials usage in the medtech area as possible can be covered.

Empa does not just carry out research on these topics within publicly-funded projects (for instance, by the Swiss Commission for Technology and Innovation (CTI) or the EU framework programmes), but also cooperates directly with companies that bring these developments onto the market as novel products and therefore strengthen the Swiss economy and competitiveness. In some cases the cooperation is so close that company employees are directly involved in research projects in Empa's labs and thus can promptly pass on the results to the industrial partners – a Joint Venture in the best sense of the word!

From materials development to applications, from spare parts in the body to whole body modelling, from medical benefits to safety research with regard to potential side effects, Empa covers the whole nine yards and provides a "one-stop shopping" solution for the Swiss medtech industry. //

1
A drop of polymer just before its "take-off" into the electric field.

2
PhD student Nicolas Lavielle (above), Matthijs de Geus and Ana-Maria Popa during an experiment.

3
Extremely thin threads result after being pulled by the electric potential.

A band-aid with many talents

The next generation of band-aids and wound dressings could simultaneously reduce pain and inhibit inflammation – and dissolve automatically when their job is done. Empa is investigating how such a multi-purpose patch can be produced.

TEXT: Rainer Klose / PICTURES: Beat Geyer, Empa

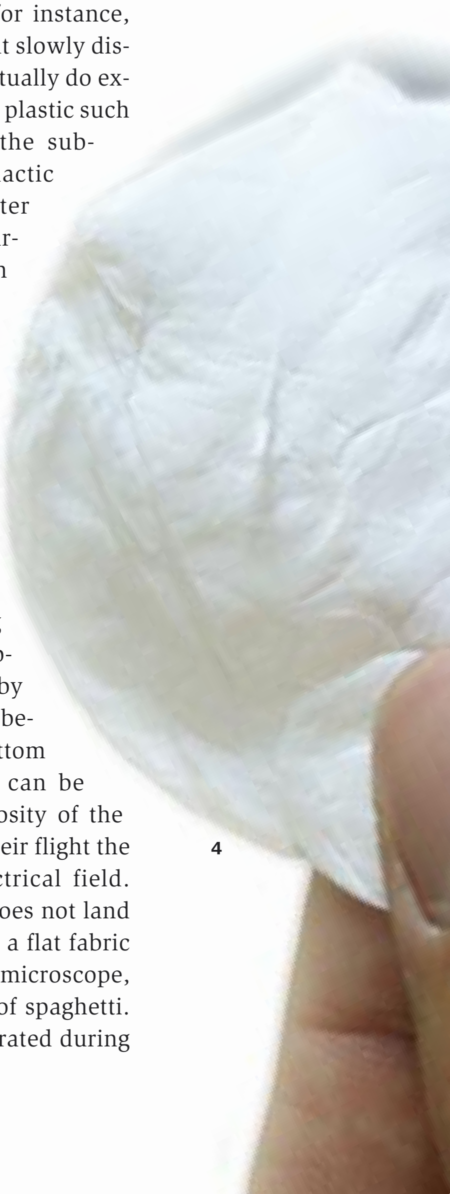
Nicolas Lavielle is holding a thin, white piece of nonwoven fabric in his hand that is as small as a cotton ball and just as soft. "This is what our experiments are currently producing", he explains. For his doctoral thesis, Lavielle developed a possible manufacturing method at Empa in St.Gallen for the wound dressing of the future. Perhaps it should be renamed: the multifunctional band-aid. Because it should not simply cover the wound but also release medication during the healing process, such as anti-inflammatory drugs or analgesics. And we are not just taking about your everyday band-aid for minor injuries that occur in the kitchen, but dressings for professional medicine. This type of fabric could be placed on injured skin beneath a plaster cast, for example. The dressing would do its job for several weeks, releasing analgesics and anti-inflammatory drugs at the site of injury until both bone and wound are healed and the plaster cast can be removed.

Slow release of drugs

A basic prerequisite for such a long-lasting effect is that the active component incorporated in the fabric is not released all at once but given off gradually. This can be achieved, for instance, by having a carrier material that slowly dissolves. Materials of that sort actually do exist in the form of biodegradable plastic such as polylactide. In the body the substance is broken down into lactic acid and eventually into water and CO_2. However, on the surface of the skin the breakdown process is significantly slower.

Pulled by high voltage

The method of choice for manufacturing fabric like this is electro-spinning. The procedure has been thoroughly investigated in recent years and has even been used on biological materials: A polymer solution is dripping out of a thin cannula. The dripping speed can be accelerated by applying an electrical voltage between the cannula and the bottom of the droplet; even threads can be pulled depending on the viscosity of the solution. At the lower end of their flight the threads swirl within the electrical field. This means that the material does not land on a neat pile but rather forms a flat fabric of polymer threads. Under the microscope, the product looks like a plate of spaghetti. The solvent has already evaporated during



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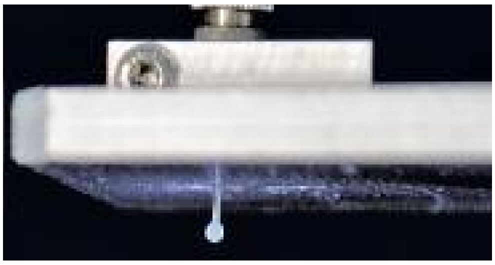

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4
The result of electro-spinning is a small cotton ball made of threads intermeshed with each other.

the flight phase. Two laboratories are collaborating on the project in St. Gallen: The technical know-how for the electro-spinning process originates from the lab for “Protection and Physiology”, the knowledge of biodynamics is provided by the “Biomaterials” lab.

For medical applications it is important not to use noxious solvents, since the end product must not contain any toxic materials whatsoever. Lavielle and his colleagues Ana Maria Popa and Matthijs de Geus therefore decided to use the polylactide bio-plastic in a mixture of acetic and formic acid. The body copes well with both acids if traces thereof were to adhere to the finished textile. Another advantage is that the acids slowly dissolve the polylactide, meaning that the molecular weight and the viscosity of the solution can be controlled in an elegant way, thus regulating the thickness of the fibres. The researchers have already succeeded in spinning polylactide to create fibres with the required diameter. Now, they are on to the next step: incorporating drugs in the polymer.

Simulated human sweat

Once that is accomplished the team wants to start trials in order to regulate the drugs’ release rate. Two parameters are crucial for doing this: the drug concentration in the fibre and the thickness of the fibres produced by electro-spinning. The thinner the fibre, the bigger the active area of the fabric and the faster the decomposition of the polylactide.

Animal testing is not required at this stage. Instead, the samples manufactured at Empa will be dissolved in special fluids that simulate human blood serum or human sweat. The results could actually be the basis for the multifunctional wound dressing of the future. This would mean that anti-inflammatory drugs and analgesics would no longer have to be administered systemically and thus flush the entire body – they would be applied exactly where they are needed: directly onto the wound. //

Video:
Elektrospinning in slow motion

http://youtu.be/NnaoT9bCaLo
For smartphone users: scan the QR code (e.g with the “scanlife” app)

Cooling apparel for MS patients

Design of biocompatible implant surfaces that promote cell and tissue growth

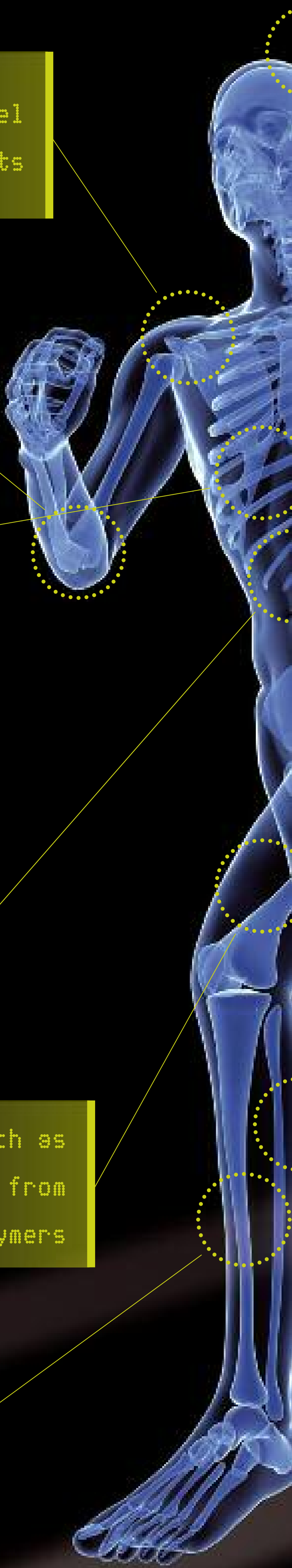
Textile sensors for health monitoring

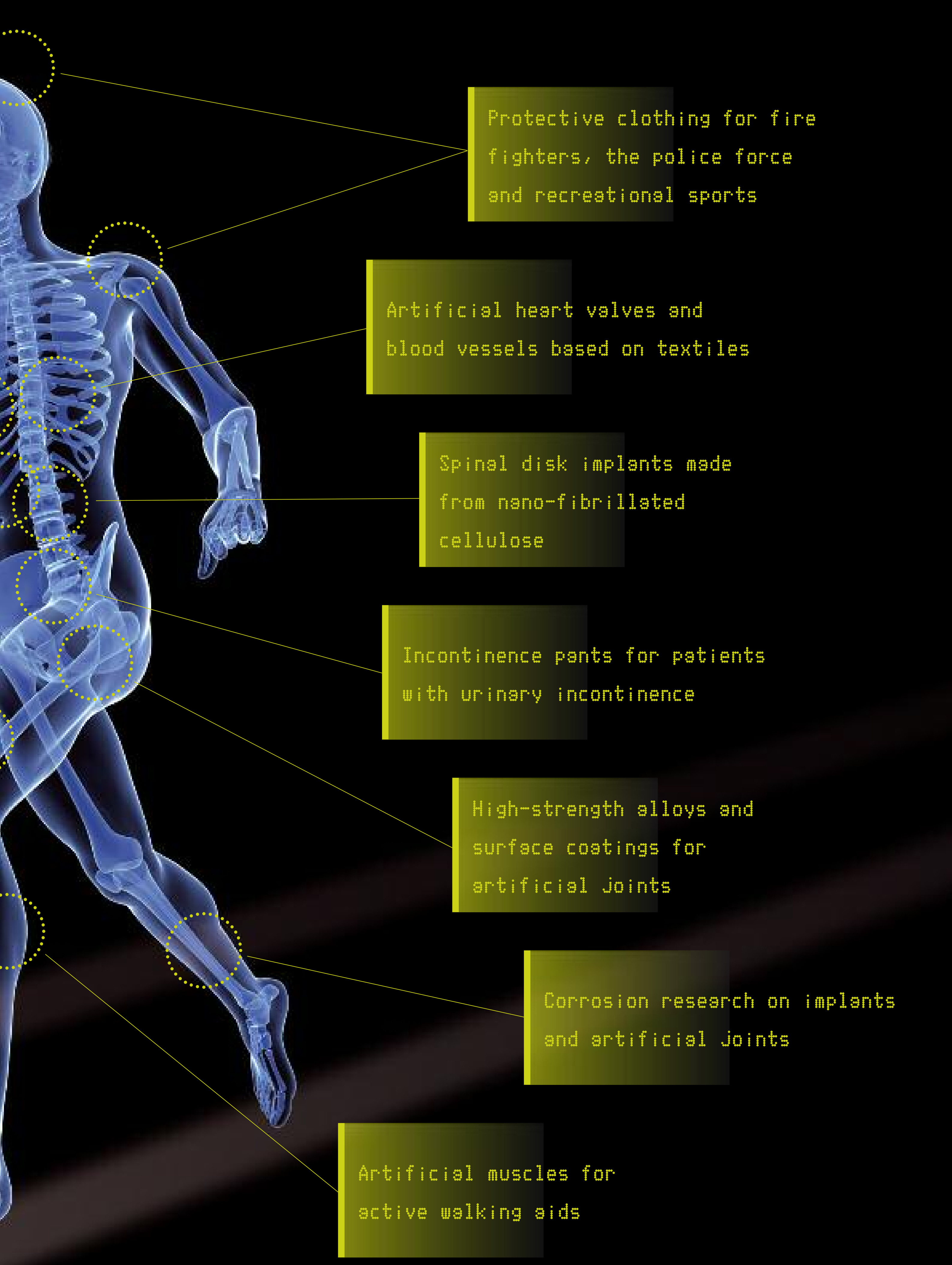
Medical Technology – made by Empa

Safety research for nano-materials and -surfaces

Medical textiles such as analgesic patches made from biodegradable polymers

Novel implant screws for improved bone healing




Protective clothing for fire fighters, the police force and recreational sports
Artificial heart valves and blood vessels based on textiles
Spinal disk implants made from nano-fibrillated cellulose
Incontinence pants for patients with urinary incontinence
High-strength alloys and surface coatings for artificial joints
Corrosion research on implants and artificial joints
Artificial muscles for active walking aids

Robert Frigg, CTO of implant manufacturer Synthes, is aware of the potential of collaborating with Empa – but he is also conscious that friction can occur in projects such as this. He already helped several cooperative research projects to mature into marketable products.

INTERVIEW: Rainer Klose / PICTURES: Synthes, Empa

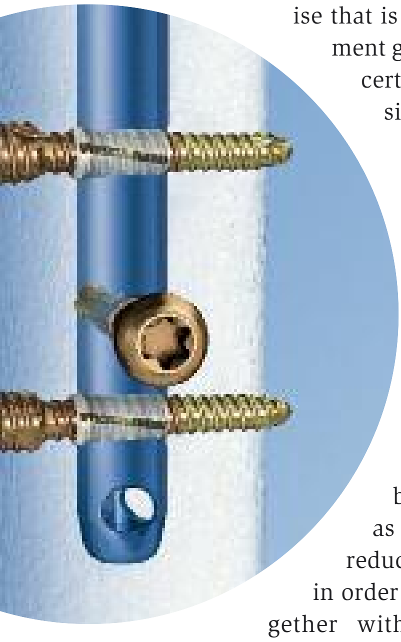
EN: Mr. Frigg, how did the collaboration between Synthes and Empa start?

Frigg: The first really large project began in 2006 with initial discussions and then started up in 2007. Prior to this, we had already placed various testing orders with Empa; collaboration up to this point in time had therefore been restricted to defined, clearly outlined orders.

What was the first big project about?

We wanted to develop an intervertebral disk in which metal interacted with metal. We asked Empa about it.

What exactly were you looking for from Empa – and what did you find? Doesn't Synthes have its own laboratories?



It is important for a company to obtain expertise that is not available in-house. A development group from industry is specialised in certain things such as metrology, design issues and matters concerning material fatigue. Then there are things that go beyond this, which are new areas. A replacement joint was new to us at that time. We developed the knowledge about the structure and kinematics of the required component together with Empa. It was particularly important to have an extremely hard layer made from so-called "diamond-like carbon" (DLC), with which we wanted as coating on the surface in order to reduce friction. We started a CTI project in order to do this, and did the research together with Empa. Two post-doctoral researchers worked on the project for us.

Was this a major step for Synthes?

It really is a completely new level. Prior to this we just placed individual orders. We say: I want that from you, how much does it cost, how long will it take? Now it is about learning together and achieving a common purpose: We want to apply this super-hard coating to our own products.

What is the situation regarding confidentiality and protection of intellectual rights? With such an important project, are you not worried that competitors can look behind the curtain in the Empa laboratories and take away results?

We are not worried about visitors entering the laboratory. There are special investigations under way that a layman is unlikely to understand. However, we must make use of our expertise for a project. And this specific knowledge turns a screw, which basically anyone can manufacture, into a high-value medical engineering product. We have known for years exactly how the screw is used, what the risks are and what is important. We pass on all of this when we enter into a partnership.

How can you protect yourself if Empa gains all of this knowledge? For example, what happens if the project has finished and one year later a competitor would like to start a similar project together with Empa? Is Empa allowed to pass on the know-how?

Can you prevent that? No. Ultimately you cannot. It it a case of protecting yourself using certain clauses when the agreement is signed – and by making a quick decision whenever progress is made: Do we want to protect this with a patent, or should we give the result to the public? But of course, the transfer of knowledge is not a one-way street: We also benefit from knowledge that Empa has obtained in their previous cooperations. Ultimately it is give and take, about fifty-fifty. Our philosophy has proven itself well so far: We check exactly what can be patented from the project, and register patents immediately.

Is it worth the risk? After all, you have your own research department. Can't you do the research yourself and maintain complete secrecy?

Yes, at Synthes we have about 700 employees in the development department, of which about 400 are engineers, physicists and chemists. However, we do not have the laboratories for such special coating problems, and do not wish to set up ones. In cases like this we achieve our goal more quickly with external experts.

Have you also come across new ideas at Empa that may be useful to your company?

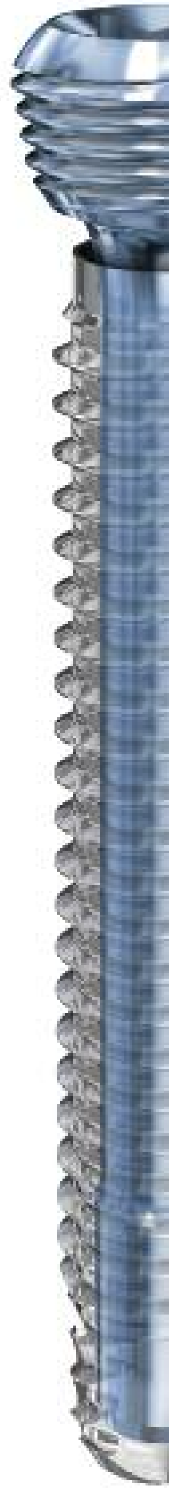
Of course! During a presentation we were shown a prototype from "compliant systems", operating forceps made from flexible materials with no joints whatsoever. This was extremely interesting to us from a production-related point of view. Such an instrument would be extremely easy to clean, and could be made from plastic if necessary. This prototype certainly gave us some new impetus when thinking about future products.

Did anything come of it?

Unfortunately, this idea did not make it to readiness for market. In this case we tried out a few things, but plastic forceps may be too big of a jump – and not useful enough in medical practice. Occasionally, the collaboration with Empa changes at a certain point. This is because the researcher is only interested in a project he can reveal (i.e. publish it). However, when further development is necessary to achieve readiness for series production, this kind of work has to take place behind closed doors. At that stage the project is no longer of interest for scientific publications. Of course, we understand this, and this part is not Empa's job at all.

In other words, as a company, you reach a point where you have to take over and continue development of the project yourself?

Yes, and that is also understandable. As an industrial company you have to understand the mentality of the researchers: They are interested in understanding a problem. Our job is to solve it. This is the difference.



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What's going on at the moment? Are you currently working on a project with Empa?

We were recently granted a CTI project dealing with colour coating on stainless steel screws. Coloured marking is a major topic in surgery – it makes it easier for the surgeon to find the right screw for a certain component immediately: He only has to tighten the blue screw with the blue screwdriver, and everything is OK. This has long since been the case with titanium screws, but it is not as easy as that with stainless steel.

Why?

With titanium, and also aluminium, thin interference coatings can be created on the surface by anodising, which makes them shine in a certain colour. This is not possible with stainless steel. With the help of our employees who are at Empa we developed a suitable coating. This has now been validated and has already gone into production.

Are you talking about employees who are working at the Empa campus? How did this model come into existence?

The idea emerged as we recognised that a postdoctorate student often has insufficient time to achieve the goal at one go. Usually the scientist comes far enough to have understood the problem. But as his contract runs out and he goes away, he cannot solve it. This is why we leave the scientists to Empa when their contract there runs out, and take them onto our salary budget. We therefore have an expert available who knows the project and its surrounding circumstances – and we also now have time to seek the solution carefully.

For how long do you use this system now?

We introduced it in 2010. It has proven itself, because the researchers also took the opportunity to accompany their "baby" and guide the project to success. This is not just a one-way street – Empa researchers during the project also meet with our specialists, and network internationally with the developer scene. The researcher therefore also learns something extra and benefits from our partnership.

Synthes CTO Robert Frigg (center) cultivates a particularly close research collaboration with Empa. His team supports him in this. Left: Cyril Voisard, the contact for Synthes researchers at Empa, right: Peter Brunner, Head of Innovation at Synthes.

Are products developed together with Empa already on the market?

Our DLS is a good example, our Dynamic Locking Screw. This special screw flexibly connects the bone to the splint. It can therefore move, which accelerates the healing process of the bone. The screw must be made from a high-strength metal alloy, which we developed and validated together with Empa. The screw is on the market since January 2012.

Mr. Frigg, thank you for the interview.

DePuy Synthes

Synthes is a Swiss/US medical engineering company with about 10 000 employees worldwide. It manufactures, produces and markets instruments, implants and bio-materials for the surgical treatment of bone fractures and for correcting and reconstructing the human skeleton and its soft tissues. In the spring of 2012 the company was taken over by US concern Johnson & Johnson and merged with the DePuy subsidiary. It now bears the name "DePuy Synthes Companies of Johnson & Johnson" and claims to be the world's biggest manufacturer of orthopaedic and neurological tools for medicine.

Corrosion in the human body

Empa investigates why even expensive alloys in implants can fail. The goal: implants that are better designed and last for longer.

TEXT: Rainer Klose / PICTURES: Empa

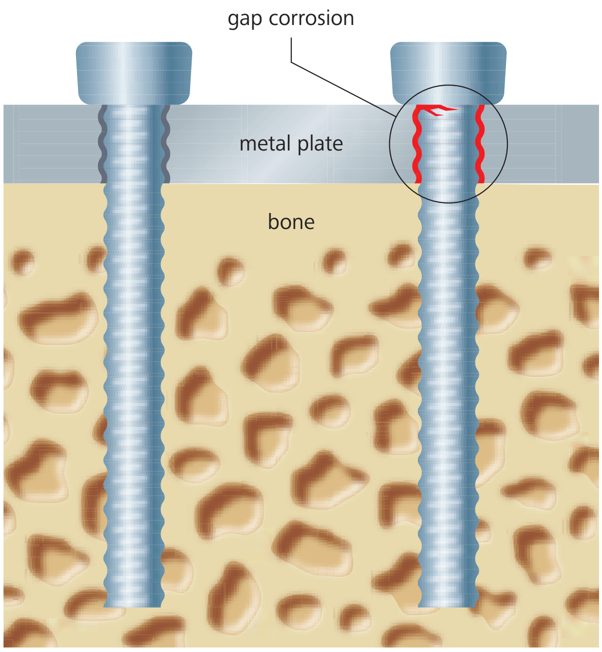
When you think about stainless steel, of cobalt/chromium/molybdenum, of titanium/vanadium – images immediately spring to mind of shiny tools that are expensive, tough and durable. They are every mechanic's dream. Something that is good enough for tools in a garage or as a component in an engine should easily withstand the conditions in the human body: mild salt solutions with a few proteins at a consistent 37 degrees C. Nothing is glowing with heat or gleaming with frost. And humans have far less horsepower than a sports car, meaning that the mechanical demands are also within reason.

"Wrong," says Patrik Schmutz. The Empa specialist for corrosion research has seen many defective artificial joints that had to be removed. He has also seen screws that have been eaten away, corroded metal parts and cracked splints. Together with partners from industry he is investigating how this can happen – and how better implants can be designed in the future.

"Gap corrosion is one main culprit," says Schmutz. "Not much happens on the surface of the implants; but the conditions in the narrow gaps between a screw and the plate that it is holding in place are dramatic." The pH value there frequently drops to 0, and the extremely acidic environment eats away at even the hardest metals. "We then face two problems," says Schmutz, "the implant loses stability and metal ions, i.e. toxic materials, travel through the body."

The Empa researchers figured out the phenomenon using physical and electro-chemical methods. These include mechanical tests such as small containers containing synthetic body fluid, in which metal test samples are moved and subjected to load for months on end. The corrosion damage is then evaluated under an electron microscope. Using a unique method the Empa experts finally investigate suspected cases of gap corrosion: they use micrometre-thin glass capillaries to examine the electrochemical processes in minute volumes. In the end, the individual pieces of the puzzle can be put together to produce an overall picture of the corrosion process.

But how can the problem be solved? "On the one hand, we have to develop new, corrosion-resistant alloys," explains Schmutz. The geometry is also decisive. "We must attempt to avoid fine gaps wherever possible and construct components that do not move against each other." The "Dynamic Locking Screw" that was developed in collaboration with Synthes (see interview on page 18) is an example of such implant technology of the next generation. But until the problem has been solved completely we better keep a watchful eye on everything that is put into the human body. //



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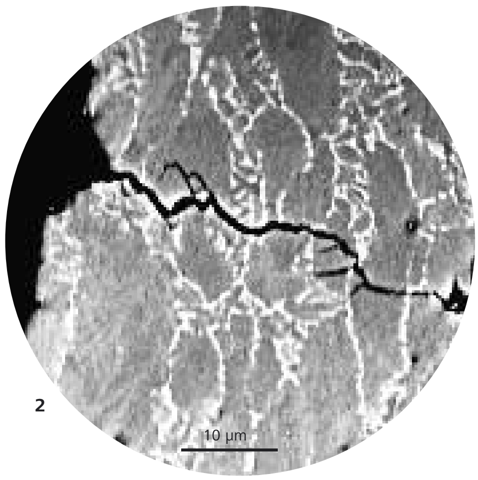

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1
Crevice corrosion arises at constricted areas between metal parts where pH drops dramatically. The acid then corrodes the alloy.

2
Corrosion on a titanium implant in an electron microscope. The material failure starts at the grain boundaries.

1
In 1940, the Tacoma Narrows Bridge in Washington State in the US was torn apart due to uncontrolled oscillations.

2
Felix Weber on his bridge model in Empa's construction hall. With it, researchers can generate specific resonant oscillations – and try out various solutions.

3
Oscillation dampers (on the right) were also placed on the support cables of the Sutong bridge in China with assistance from Empa.

1

The bridge whisperer

Sometimes bridges just go berserk. The deck and the cables vibrate heavily, and the bridge has to be closed. This is a case for Felix Weber. He knows how to get these resonance problems under control using hydraulic dampers, counterweights and electronic controllers and make the shaking structures see reason.

TEXT: Rainer Klose / PICTURES, ILLUSTRATIONS: Empa

Every bridge is unique. Made to measure at their location, designed by architects who want to deliver something elegant. The bridge must be filigree rather than lumbering, airy rather than bulky, a real jewel. However: Sometimes it doesn't work. The most infamous example of an extremely slender bridge with a wide span is (or better: was) the "Tacoma Narrows Bridge" in Washington state in the US. Known as "Galloping Gertie" by its fans because of its see-sawing road surface, it collapsed in November 1940 just four months after opening. The deck cracked in a storm and fell into the water, together with two abandoned cars. The wreckage is still on the bottom of the Tacoma Narrows, where it has been placed under a preservation order.

Such a drastic resonance phenomenon has never occurred since, but vibration is still a problem as far as bridges are concerned. In June it affected the "Millennium Bridge" designed by star architect Norman Foster, a footbridge over the Thames in London – on its very opening day! Its load-bearing capacity was designed for 5000 people, but less than 200 people were enough to start a considerable amount of vibration. Investigations revealed that the vibration that occurred made people walk in lockstep, which made the vibration even worse. Two days after opening, the "Millennium Bridge" was shut and passive mass dampers were installed: Steel weights topping 20 tons to counter the horizontal vibration and even 50 tons to counter the horizontal vibration – exactly adjusted to the pedestrian-induced vibration frequency that had made the bridge so dangerous.

When the wind whistles through the cables

However, what can be done if the trigger cannot be calculated so precisely beforehand? What if multiple factors play a part? During heavy winter storms in March 2005, the support cables of the Franjo Tudjman Bridge in Croatia, which spans an estuary north of Dubrovnik, started to vibrate. The damp snow had stuck to the cables and given them a kind of "wing profile", which made it easier for the wind to excite vibration. Felix Weber, a specialist for active damping in Empa's "Structural Engineering" laboratory, knew exactly what to do: just install his new electronically controlled adaptive cable damping system developed together with Munich-based Maurer Söhne. Sensors record the vibration of each cable and relay the signal to a computer, which then actuates the magneto-

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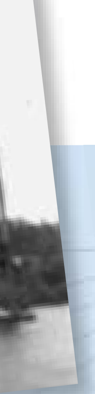

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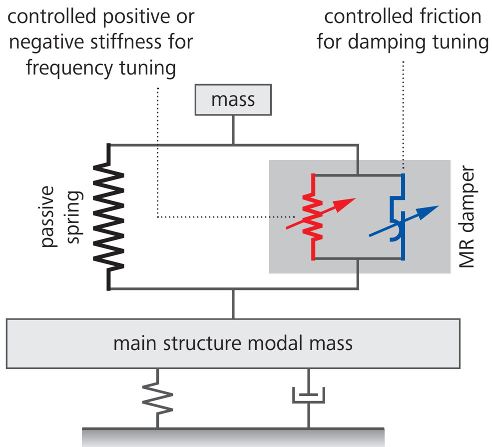

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rheological dampers (MR dampers) individually. In this way, the system manages to suppress vibration in the best possible way, independently of frequency and amplitude.

Thus far, the cables of the Franjo Tudjman Bridge have maintained their stability for six years. Weber then turned his hand to the largest cable-stayed bridge in the world at that time: the Sutong Bridge in China, which crosses the Yangtse with a free span of 1080 metres. Weber helped the Chinese to stabilise the cables, which are up to 540 metres long, with 48 MR dampers and 224 passive oil dampers. The adaptive cable damping system was installed during the construction of the bridge and has proven itself to this very day. Currently, the cables of the Russky Bridge crossing the sea between Vladivistok and "Russky Island" with the world's longest free span of 1104 metres, which are up to 580 m in length, are being equipped with controlled MR dampers.

Wobbly girder bridge

Meanwhile, Felix Weber has new targets; instead of "only" providing cables with adaptive damping, he now wants to take on entire bridges. Such an opportunity arose in Volgograd. Again, a bridge had unexpectedly started to vibrate. Only this time it wasn't a cable-stayed bridge but a girder bridge – the longest in Europe at 7.1 kilometres. It took 13 years to build the road bridge over the Volga, which opened in 2009. In May 2010 winds were so strong that the deck of the bridge started to vibrate dangerously at three frequencies – 0.45, 0.57 and 0.68 Hertz. The constructors decided to use Weber's brand new damping concept for bridge deck vibrations, a MR-controlled mass damper.

Weber, a mechanical engineer by training, can fall back on a unique test set-up at Empa in order to test his latest developments in practice: In one of the halls at the Empa campus in Dübendorf there is a 20 metre-long cable-stayed bridge that is in the dry all year round. He had already developed his cable damping system on this lab bridge. The elegant thing about Weber's innovative solution for vibrating building structures: Whereas passive mass dampers such as the ones on the Millennium Bridge in London are "tuned" to a pre-calculated frequency, an MR-controlled mass damper adapts to any measured vibration frequency – which makes the damping significantly more efficient. Or to put it another way: A light adaptive mass damper yields the same performance as a considerably heavier passive damper. The mass damper of the 1.7 ton Empa lab bridge weighs just 27 kilograms and is attached to the bridge via springs.

Variable damping for any frequency

The 7.1 kilometre, three-lane Volgograd road bridge requires dampers that are somewhat bigger, of course. Weber and Maurer decided to damp the three vibration frequencies with three 21-ton spring mass systems that were adjusted to these frequencies. In order to install the mass dampers in the slimline bridge deck, they first had to be "chopped up" into four pieces, each weighing more than 5 tons. The system has been operating reliably since last autumn. By way of comparison: Twelve years earlier more than 70 tons were required to stabilise the Millennium Bridge, which was only 370 metres in length. The adaptive mass damper from Empa, therefore, has some "weighty" advantages. Empa partner Maurer Söhne now also markets the new concept for one- and two-dimensional vibration damping on skyscrapers, observation towers and airport towers. //

1
Diagram of a controlled mass damper

2
Felix Weber shows how an MR damper helps him come to grips with oscillations on his bridge model. Middle: an adaptive mass damper on the bridge model. Below: Felix Weber tests the original weights for the Wolograd bridge prior to assembly.

Video:
When bridges go beserk

http://youtu.be/lLo_-u2EqJg
For smartphone users: scan the QR code (e.g with the "scanlife" app)

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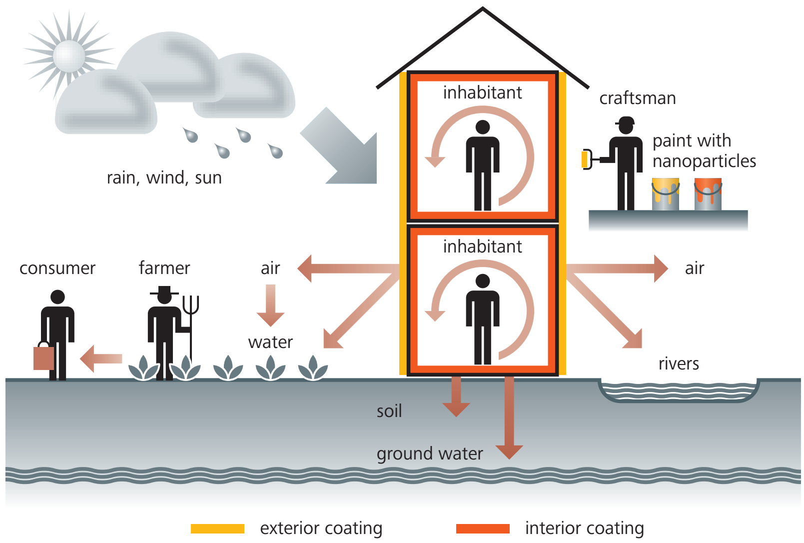

Nanoparticles in a house. Where do they finally go?

Nanoparticles in paint: a good idea?

House façades have to withstand quite a bit of stress: UV radiation, temperature fluctuations, rain and abrasion. A new generation of nano-additives could counteract these effects better than ever before. But is it risky to mix them into the façade paint?

TEXT: Rainer Klose / ILLUSTRATION: André Niederer

In the EU-funded "Nanohouse" project, the opportunities and risks of these nano-additives are examined from an ecological and toxicological point of view. Several Empa teams are investigating whether and how nano-materials are released from façade coatings during the entire product lifecycle, and what their possible effects on the environment and human beings might be.

Rather unique about this project: it not only looks at newly manufactured nano-materials but also at coatings that were "aged" and exposed to various influences. For this purpose, new methods had to be developed in different areas.

Blessing and curse of oxidation

As well as nano-silver for interior façades, nano-titanium dioxide and nano-silica materials for exterior and interior coatings were examined. Nanoparticles made from titanium dioxide can be activated by sunlight to chemically decompose dirt particles and other substances (a process known as photo-catalysis). This means that the dirt could be simply washed off by rain, making the paint "self-cleaning", so to speak, and therefore more durable.

However, this could also cause organic binding agents in the paint to oxidise. Empa is investigating how the paint actually reacts by artificially weathering façades. The researchers simulate the effects of the environment and various weather conditions by illuminating the façades with artificial sunlight, for example. The paint ages considerably faster by means of intensive artificial weathering, thus showing the researchers what happens if the rain washes off not just the dirt but also the aging paint.

Biological effects on humans and animals

Five Empa laboratories are involved in the "Nanohouse" project, which will examine the use of nanoparticles in paint over a three and a half year period. Lifecycle analyses of these nano-paints, the functionality and longevity thereof and the release of different nanoparticles and their potential biological effects on humans and the environment are examined. Besides Empa, eight partners are involved, four of which are from industry. At just about half-time, the project is still in progress.

Once finished, the scientists hope that they will have established the basics for a new generation of wall paint: Coatings that are harmless to people and the environment in the long-run. Because paint that lasts longer reduces paint usage and therefore also contributes to protecting the environment. //

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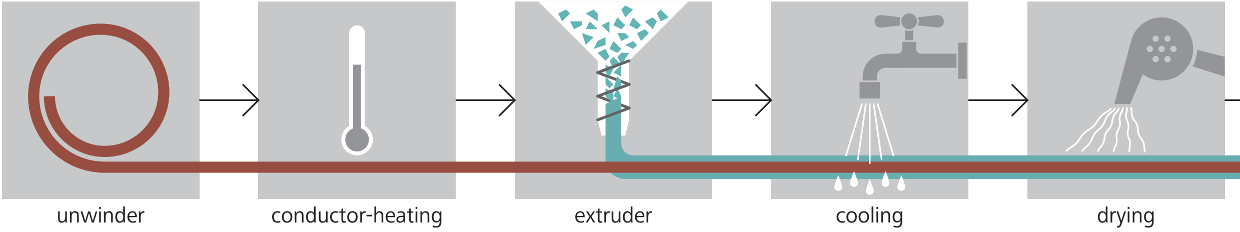


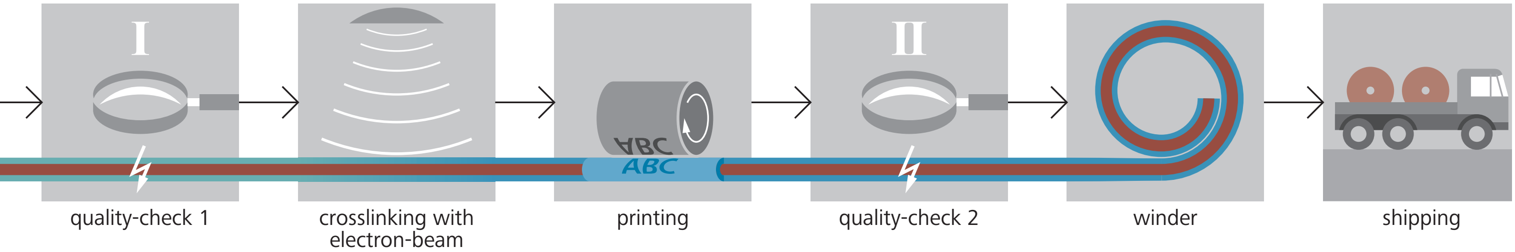
An eco-friendly factory

In the CTI-funded research project "EcoFactory", Empa researchers are working with industrial partners, economists from the ETH Zurich and computer scientists from the HTW Berlin to develop software, with which companies can determine the most energy saving processes for their manufacturing facilities.

TEXT: Martina Peter / PICTURES: Empa / ILLUSTRATION: André Niederer

It's all go at cable manufacturer Huber + Suhner. Every process in the factory is in place – from the delivery of the copper wire to the finished reel of cable. This is also necessary, because high-tech cables from Pfäffikon in Zurich have to withstand quite a few things, they must continue to function in extreme cases such as when being used as jumper cable in trains. The prducts hold up to their promise thanks to a unique treatment using electron beam polymerisation: the plastic is blasted with electrons and made "unmeltable". This provides the cable with a sheath that withstands even the highest temperatures.

Costs are kept down in the factory using an on-demand system, low storage costs and a high degree of machine utilisation. In spite of this, Peter Schmollinger, process technology manager at Huber + Suhner, is continuously thinking about individual stages of the process. On the one hand because it is his job to improve existing processes and develop new ones, but also because the company puts value on examining the ecological effects of their activities. "Companies know their material and wage costs. But what costs do the hidden energy consumers generate?" asks Schmollinger. He wants to to know the facts: Does it make ecological sense to keep the plastic in the extruder that puts the sheath around the cable warm all the time? Or would it be better

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1
Functional diagram of a cable factory.

2
A worker discusses a material sample from the cable factory with process engineer Peter Schmollinger.

from an energy point of view to allow the polymer compound to cool down during production breaks and heat it up again when it is needed?

Individual steps in the process would also have to be organised differently from an ecological aspect wherever possible, thinks the precision engineer. In Pfäffikon the cable runs through a water bath to cool after the sheath has been extruded. A high-pressure dryer dries it a a few metres further on. Now, does this make sense energywise, or could the cooling and drying process be organised in a better way that would save energy? Are there any alternative drying methods? Can these be operated in a financially acceptable way that allows the same amount of cable to be produced within the same time? Because Schmollinger is sure of one thing: "No company wants a green factory that doesn't earn anything".

"EcoFactory" combines financial and ecological perspectives

As a process engineer he has a gut feeling for the direction, in which things must go. However, by means of the joint "EcoFactory" project together with Empa and the ETH Zurich he hopes to obtain feedback that is more objective. The core of the project is a software that simulates how processes should be set up and coordinated in an ideal way, so that the company can reach both financial and ecological targets. And precisely this "not only – but also" between market and environment is the new thing about "EcoFactory"; the program does not just model economic variables such as utilisation, timing, idle times (i.e. overall cost-effectiveness), but models, evaluates and optimises processes with regard to sustainability. Anyone who would like to organise processes in a factory more ecologically is quickly confronted with lifecycle assessments (LCAs), dealing with resources, CO_2 emissions and disposal of waste products – all of which are extremely complex issues.

Empa's lifecycle assessment know-how

This is exactly where Empa comes in. Empa researchers contribute their expert LCA knowledge and the "ecoinvent" database (see box). They have many years of experience with systematic analysis of the environmental effects of products during their overall lifecycle. "Actually, we look at things in a similar way to the economists," says Empa researcher and LCA expert Rainer Zah, "we are also always looking at the entire value chain." According to Zah, many manufacturing companies would have realised that they should integrate the ecological perspectives into

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process management, which to date has been financially driven in most cases. But where do you start? For example, if you wish to purchase a new, more efficient machine, you have to know whether you can save money by using less energy and smaller quantities of auxiliary materials and adhere to the legal limits.

The EcoFactory software will help you do this in future. If the financial model is directly coupled to the methods and data for LCA, companies can determine which machines run for how long in a manufacturing process and which materials they require. They can also simulate emissions, reveal resource consumption and record waste products. Because the ecological dimension is by no means limited to energy, says Zah.

By the end of 2013 when the project will be finished, the tool should be developed to a stage where it can be used commercially. Large companies that have their own environmental department can use the tool themselves, and SMEs will be in a better position to approach energy agencies with specific questions. Now, at "half-time", ETH and Empa scientists often visit their industrial partners. "These are all companies that are already ahead in terms of protecting the environment, but want to take it even further," declares Zah. "This makes the work extremely interesting."

Collecting and analysing data

As one of the industrial partners, Peter Schmollinger from Huber + Suhner is currently making "his" processes available for recording and analysis. At the end of May the ETH team recorded a full week of production, during which about 3500 m of high-tech cable was manufactured. They recorded each production step at one-second intervals: during extrusion, water cooling and electron beam polymerisation. This provided them with key figures for energy consumption, emissions, water usage and material flows.

Once the pieces of the puzzle have been put together, new processes, in which the work operations take place in a different order, can be simulated and the best cost-effectiveness can be determined. More than a dozen similar systems are available at Huber + Suhner, to which the optimisation could be transferred. And of course, the knowledge that is gained can also be used for new manufacturing facilities. Even if these are extremely specialised – such as the new electron beam polymerisation system next to the factory building, where the walls of the concrete bunker are several metres thick and the cables are processed in a high-vacuum. //

Engineer Peter Schmollinger scoures the factory for energy "leaks". Top: the unwinder at the start of cable manufacturing. Below: the cooling basin, through which the cable runs after the plastic insulation has been applied.

Who is developing "EcoFactory"?

"EcoFactory" is software for companies that do not just want to optimise their manufacturing processes financially but also ecologically. It is currently being developed within the scope of a project supported by the Commission for Technology and Innovation (CTI); besides Empa, other partners in the CTI project are the ETH Zurich, the Hochschule für Technik und Wirtschaft HTW Berlin (Berlin University of Applied Sciences) and industrial partners Taracell Switzerland, Huber+Suhner AG, Knecht & Müller AG, Chocolat Frey AG, Effizienzagentur Schweiz AG (Efficiency Agency Switzerland AG), the SWISSMEM industry association and the R&D consortium "Sustainable Engineering Network Switzerland" (SEN).

"The Sun Moves" exhibition at the Swiss Museum of Transport in Lucerne. Empa researcher Thomas Geiger explains to a visitor how the rotating, coloured solar cells operate.

Moved by sunlight

Thanks to Empa, the current exhibition at the Swiss Museum of Transport in Lucerne entitled "The Sun Moves" has got a new attraction. A display cabinet full of colourful, rotating solar cells demonstrates the power of sunlight, and should give visitors food for thought.

TEXT Rainer Klose / PICTURES: Empa, Swiss Museum of Transport

A work of art, the "Solar Window" was designed and developed by artist Daniel Imboden and Thomas Geiger, a researcher in Empa's "Functional Polymers" laboratory. Nine transparent, multi-coloured solar cells rotate slowly in a frame around their own axis. The silent movement and the coloured shadows the installation casts on its surroundings exude calm, and make you think about the power of the sun, thus perfectly exemplifying the subject of the exhibition: "The Sun Moves". The exhibition in the Swiss Museum of Transport puts the focus on sustainable mobility. Means of transport that obtain their power from solar energy are exhibited. Besides a solar-powered car (which spontaneously comes to mind on this subject), sailing boats and gliders are also featured. Because after all, thermals and wind power also originate from the sun.

Special solar cells for diffuse light

Empa researcher Thomas Geiger and Swiss company Solaronix decided that the "Solar Window" should be equipped with a special type of solar panel. The so-called Grätzel cells, named after their inventor Michael Grätzel, researcher at ETH Lausanne, capture sunlight using various organic dyes instead of silicon. As well as having a more friendly, colourful look, this also has other advantages: The cells are transparent and also function in diffuse light. The play of colours therefore does not just rotate in the glistening sun, but also in the partial shade of the exhibition between wall charts and wandering visitors. Each cell provides the power for its own movement.

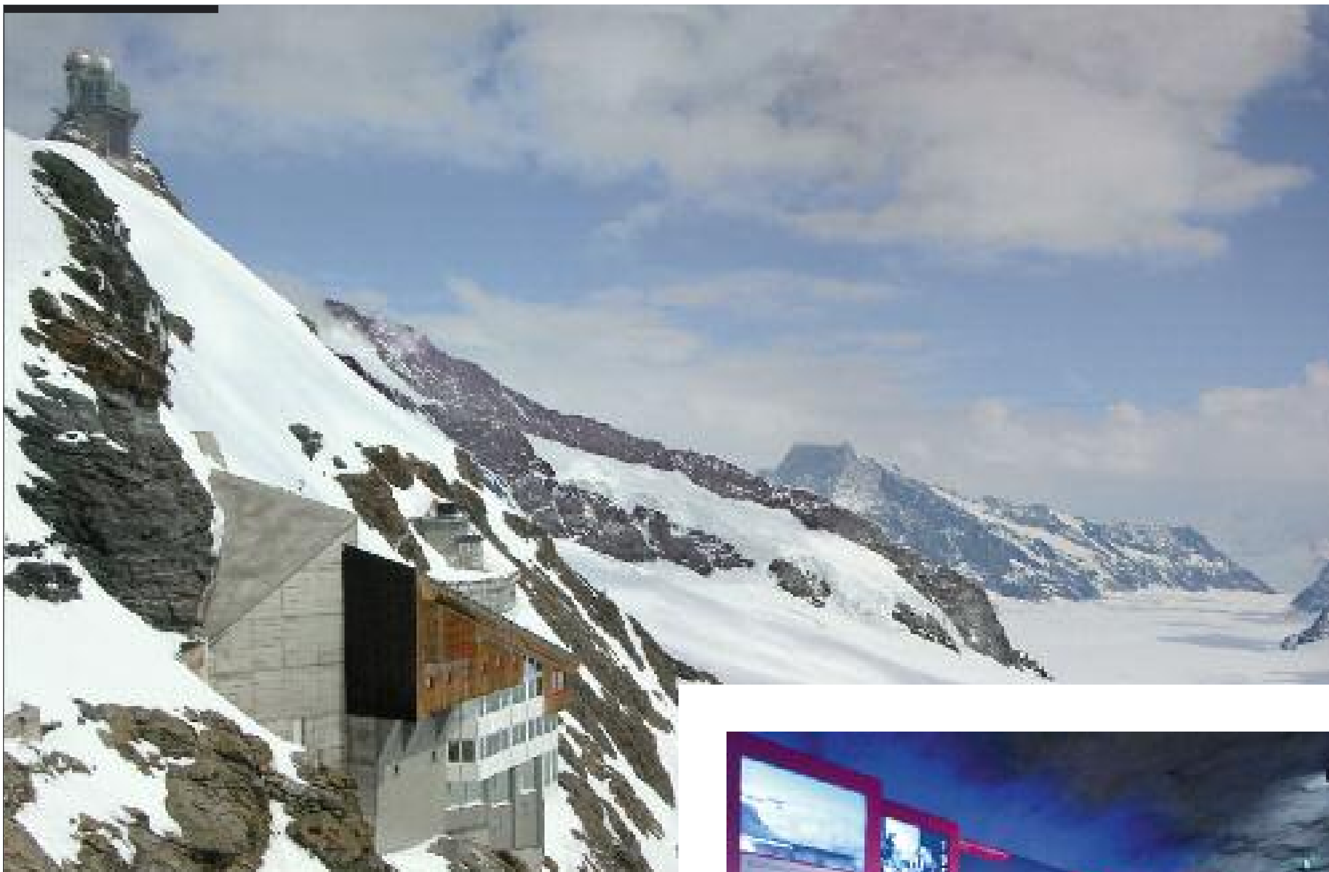
Three colours – three stages of development

The three colours of the exhibit are also symbolic of the development of the Grätzel cell, which was first described and patented 20 years ago. The dark red elements function with the original dye, a ruthenium complex, which Grätzel used in his first cells. The turquoise-coloured cells use chemistry that has been developed in the Empa laboratory, based on squarine dyes. The orange-coloured cells are a new development by Solaronix, a company that has been commercially developing the technology since 1993. //

The "The Sun Moves" exhibition is open daily from 10 am until 6 pm and runs until 21st October in the inner courtyard of the Swiss Museum of Transport, Lidostrasse 5, 6006 Lucerne, Switzerland. More information can be found at *www.verkehrshaus.ch*

Video:
Solar art at Swiss Museum of Transport

http://youtu.be/UkLJKqw7zrs
For smartphone users: scan the QR code (e.g with the "scanlife" app)



Anniversary at the "Top of Europe"

Measuring airborne pollutants at the Sphinx observatory on Jungfraujoch since 1973, Empa has been instrumental in determining air quality, not just in the Alps but throughout Europe. This is because everything that pops up at Jungfraujoch and is detected there has to come from somewhere or other. The route the pollutants have taken – and therefore their origin – is calculated with weather models from Meteo Schweiz. The series of measurements that Empa started in 1973 is among the longest in Europe, and is invaluable to researchers all over the world.

The research station on Jungfraujoch is, however, considerably older: The outpost at 3571 metres altitude was opened in 1931 – initially as an astronomical observatory and a laboratory for altitude sickness. The Sphinx observatory, named after the peak on top of which it is perched, followed in 1937 – i.e. exactly 75 years ago. Nowadays more than two dozen international research groups work at the centre each year. 20 automatic measuring instruments are constantly in operation, monitoring weather, radiation and atmospheric data.

On the occasion of the 100th anniversary of the Jungfraujoch railway, which began operation in 1912, the scientific work is now the subject of a permanent exhibition with display boards and video documentations. The research station on Jungfraujoch is the highest research station in the world that can be reached by public transport.

Video:
Research at Jungfraujoch

www.empa.ch/EN37-2
For smartphone users: scan the QR code (e.g with the "scanlife" app)

Young entrepreneur award for Empa start-up

The winner of the first “SwissParks.ch Award” and therefore the “Start-up of the Year 2012” is QualySense AG, an Empa start-up. The prize worth 10,000 Swiss Francs was awarded by the Swiss Business Group and Assoii-Suisse (Associazione degli Imprenditori Italiani in Svizzera) in Lugano on 22 May. The intention of this award from SwissParks.ch – an association of Swiss technology parks and business incubators established in the year 2000 – is to recognise fledgling companies, which have market potential and exemplify Switzerland as a place for high-tech, research and development with their innovative products.

The winner, QualySense AG, develops high-end solutions for sorting grain, seeds and beans. Their product, the QSorter, checks the basic biochemical and/or geometric properties of each individual grain of the product that is being inspected, and sorts it according to customer-specific criteria. The customer, therefore, achieves continuous quality control, process optimisation and and risk minimisation. QualySense was founded in 2010 by Francesco Dell'Endice and resides in the Glatec technology centre on the Empa campus in Dübendorf.

From left to right: representative of Winterthur Instruments GmbH, Jean-Philippe Lallement (Chairman of SwissParks.ch), Paolo D’Alcini (COO of QualySense), Nicola Rohrseitz (CEO of ViSSee).

Events

14. August 2012

Neue Antriebstechnologien: Von der Forschung zur Markteinführung
Info: www.e-mobile.ch
Empa, Dübendorf

4. September 2012

Hightechnähte aus der Forschung – Laserschweissen von Textilien und Membranen
Empa, St.Gallen

25. Oktober 2012

Tage der Technik 2012: Die Stadt der Zukunft – die Zukunft der Stadt
Info: www.swissengineering.ch
Empa, Dübendorf

12. November 2012

MedTech Day 2012 – Von der Idee zum MedTech-Produkt
Empa, Dübendorf

Your way to access Empa's know-how:

Portal
portal@empa.ch
Phone +41 58 765 44 44
www.empa.ch/portal