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1 Quick detection of periodontitis pathogens

Twelve million Germans suffer from periodontitis, an inflammation that can lead to the loss of teeth if left untreated. A new diagnostic platform enables the pathogens to be detected quickly, enabling dentists to act swiftly to initiate the right treatment.

2 Turning smartphones into secure and versatile keys

It's already possible to open doors using an app – but we are a long way from seeing widespread acceptance of this in the market. Now, researchers have developed a piece of software that will make the technology even more secure and versatile.

3 Romper suit to protect against sudden infant death

Breathing sensors built into romper suits could help prevent sudden cot deaths in the future. The basis for this is a stretchable printed circuit board that fits to the contours of the body and can be manufactured using routine industrial processes.

4 Smart search engines for news videos

Searching for video recordings regularly pushes search engines to their limit. The truth of the matter is that purely automatic algorithms are not enough; user knowledge has to be harnessed, too. Now, researchers are making automated engines smarter.

5 Giant tobacco plants that stay young forever

Tobacco plants bloom when they are just a few months old – and then they die. Now, researchers have located a genetic switch which can keep the plants young for years and which permits unbounded growth. In short, an ideal source of biomass.

6 Noise protection – multifunctional and aesthetical

Noise abatement is growing in importance, thus, the demand for better acoustic building components raises. Scientists are developing new solutions: aesthetically good looking and flexibly applicable microperforated sound absorbers.

7 Physio for the home

Accidents or operations are often followed by long periods of rehabilitation treatment. In future, a new technology will allow patients to do physiotherapy exercises at home, while still making sure that they are performing movements correctly.

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The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 60 Fraunhofer Institutes at over 40 different locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of around 20,000, who work with an annual research budget totaling 1,8 billion euros. Roughly two thirds of this sum is generated through contract research on behalf of industry and publicly funded research projects. Branches in the USA and Asia serve to promote international cooperation.

Editorial Notes:

RESEARCH NEWS | Frequency: monthly | ISSN 09 48 - 83 83 | Published by Fraunhofer-Gesellschaft | Press Office | Hansastraße 27 | 80686 München | Phone +49 89 1205-1333 | presse@zv.fraunhofer.de | Editorial Staff: Franz Miller, Janine van Ackeren, Tobias Steinhäuser, Britta Widmann | Reprints free of charge. We encourage you to favor the online version and newsletter via www.fraunhofer.de/fhg/EN/press This bulletin is also available in German as FORSCHUNG KOMPAKT.

Quick detection of periodontitis pathogens

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Bleeding gums during tooth brushing or when biting into an apple could be an indication of periodontitis, an inflammatory disease of the tissues that surround and support the teeth. Bacterial plaque attacks the bone, meaning teeth can loosen over time and in the worst case even fall out, as they are left without a solid foundation to hold them in place. Furthermore, periodontitis also acts as a focal point from which disease can spread throughout the entire body: If the bacteria, which can be very aggressive, enter the bloodstream, they can cause further damage elsewhere. Physicians suspect there is a connection between periodontitis pathogens and the sort of cardiovascular damage that can cause heart attacks or strokes. In order to stop the source of inflammation, dentists remove dental calculus and deposits from the surface of teeth, but this is often not enough; particularly aggressive bacteria can only be eliminated with antibiotics.

Of the estimated 700 species of bacteria found in the mouth cavity, there are only eleven that are known to cause periodontal disease in particular; of these, some are deemed to be severely pathogenic. If these biomarkers are present in the gingival sulcus – the small gap around the base of the tooth – then the patient is at high risk of a severe form of periodontitis. But the only way to find out is by conducting a bacteria test. The problem is that current methods for identifying pathogens are time-consuming and must be carried out in an external contract laboratory. Conventional bacterial analysis using microbial culture carries the risk of bacteria being killed as soon as they come into contact with oxygen.

Bacterial analysis in less than 30 minutes

A new mobile diagnostic platform is designed to speed up identification of the eleven most relevant periodontitis pathogens considerably. Scientists at the Fraunhofer Institute for Cell Therapy and Immunology IZI in Leipzig have collaborated with two companies, BECIT GmbH and ERT-Optik, to develop a lab-on-a-chip module called ParoChip. In future this will allow dentists and medical labs to prepare samples quickly and then analyze the bacteria. All the steps in the process – the duplication of DNA sequences and their detection – take place directly on the platform, which consists of a disk-shaped microfluidic card that is around six centimeters in diameter. “Until now, analysis took around four to six hours. With ParoChip it takes less than 30 minutes. This means it’s possible to analyze a large number of samples in a short amount of time,” says Dr. Dirk Kuhlmeier, a scientist at the IZI.

The analysis is conducted in a contactless and fully automated manner. Samples are taken using sterile, toothpick-shaped paper points, after which the bacteria are removed from the point and their isolated DNA injected into reaction chambers containing dried reagents. There are eleven such chambers on each card, each featuring the reagent for one of the eleven periodontal pathogens. The total number of bacteria is

determined in an additional chamber, via polymerase chain reaction (PCR). This method allows millions of copies of even tiny numbers of pathogen DNA sequences to be made. In order to generate the extremely quick changes in temperature that are required for PCR, the disk-shaped plastic chip is attached to a metal heating block with three temperature zones and mechanically turned so it passes over these zones. This causes a fluorescent signal to be generated that is measured by a connected optical measuring device featuring a fluorescence probe, a photo detector and a laser diode. The key benefit is that the signal makes it possible not only to quantify each type of bacterium and thus determine the severity of the inflammation, but also to establish the total number of all the bacteria combined. This enables doctors to fine-tune an antibiotic treatment accordingly.

“As the connected optical measuring system allows us to quantify bacteria, ParoChip is also suited to the identification of other bacterial causes of infection, such as food-borne pathogens or those that lead to sepsis,” says Kuhlmeier, who goes on to emphasize further advantages of the compact diagnostic platform: “Using ParoChip does away with many of the manual steps that are a necessary part of current bacteria tests. The synthetic disks can be produced cheaply and disposed of after use in the same way as disposable gloves.” Already available as a prototype, ParoChip is initially intended for use in clinical laboratories; however it could also be used by dentists to carry out in-house analysis of patient samples in their own practice.



Dentists use sterile paper points to remove bacteria from the tooth. (© Fraunhofer IZI) | Picture in color and printing quality: www.fraunhofer.de/press

Turning smartphones into secure and versatile keys

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Smartphones and tablets have become an integral part of our daily lives. The capabilities of these handily sized mini-computers seem almost boundless as we phone friends, shoot holiday snaps, lose ourselves in a new music download or access the internet to obtain the boarding card for our next flight in comfort. Does it not seem logical, then, that we should make use of these constant companions as the key to our cars, front doors or lockers as well? A few such solutions are already available, but what's still missing is widespread market acceptance. At this year's CeBIT trade fair in Hannover (March 5-9, 2013), researchers from the Fraunhofer Institute for Secure Information Technology SIT in Darmstadt will be demonstrating their ShareKey software, a solution which will make the key app concept even more versatile and secure.

"In essence, ShareKey offers two new functions: users can issue digital keys remotely and assign these keys certain user permissions. For instance, I can grant the building superintendent access to my apartment for a short period so that he can open the door for the gas meter to be read while I'm at work," explains Alexandra Dmitrienko from the SIT. "The solution is built around modern security technologies and can be easily integrated into existing access control systems." ShareKey sends electronic keys directly to the user's mobile phone, in the form of a QR code attached to an e-mail or MMS.

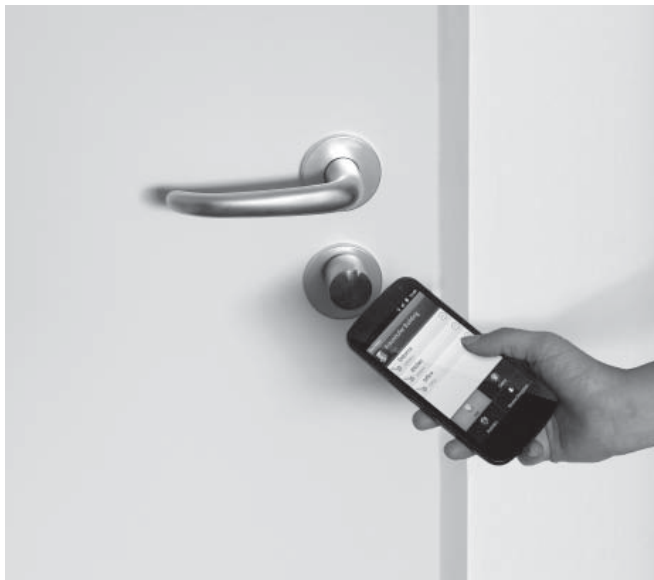
Protecting parcel stations from phishing

One thing that Dmitrienko and her team will also be demonstrating at CeBIT (Hall 9, Booth E08) is a parcel station where access rights to individual compartments are issued using ShareKey. "Recently, users of parcel stations have fallen victim to phishing attacks. Equally, hackers continue to target their efforts on smartphones. In light of this, the big challenge was to protect the electronic keys without compromising the intuitive operation of such devices," explains Dmitrienko.

ShareKey works using the Near Field Communication (NFC) transmission standard, which allows data to be exchanged wirelessly over short ranges of up to a few centimeters. "To open a door, all you need to do is hold your mobile phone close to the lock," says Dmitrienko. NFC interface and door locks only operate within a narrow bandwidth and have limited computing power. Consequently, scientists at the SIT have equipped ShareKey with particularly resource-efficient communication protocols. Further, electronic keys are reliably protected on the smartphone from malware and unauthorized access. This is achieved by leveraging advanced technologies which keep sensitive data on the smartphone separate from other data and apps (e.g. Fraunhofer's BizzTrust).

Communication between the mobile phone and a central server is protected by established security protocols. "And even if this communication is hacked into, it's impos-

sible for unauthorized people to gain access to the digital key. This is because opening the door requires information contained both in the encrypted token sent to the user and in the app installed on their smartphone," clarifies Dmitrienko. Alongside front doors and parcel or locker compartments, the research scientist also suggests that the technology could potentially be applied to help administer keys in hotels or as part of car-sharing schemes. "The trend towards a 'shareconomy' will benefit the further development of this technology," concludes Dmitrienko. So the era of mobile phones as keys is one step closer.



Thanks to ShareKey, digital keys can be transferred by e-mail using a smartphone. (© Fraunhofer SIT) | Picture in color and printing quality: www.fraunhofer.de/press

Romper suit to protect against sudden infant death

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Parents of newborn babies are always creeping into the nursery at night to check that their infant is still breathing. Alternatively, they might let baby sleep in their room, hoping to notice any respiratory arrest and intervene before it is too late. In future, a romper suit with an integrated sensor system could warn parents as soon as their child stops breathing. The cornerstone of the sensor system is a stretchable printed circuit board that fits to the contours of the body, making it hardly noticeable. It was developed by researchers at the Fraunhofer Institute for Reliability and Microintegration IZM in Berlin. To demonstrate one of the many possible applications of the stretchable PCB, scientists fitted it with two commercially available sensors and ironed the whole system onto a romper suit. This allows them to monitor breathing in the chest and stomach areas.

The circuit board is made of polyurethane, also known as PU. This is a cost-efficient material more commonly used for coating surfaces, as a sealant, or as a cushioning material. "The circuit board we have developed can be manufactured using routine industrial processes, meaning a high throughput and, consequently, good cost-efficiency," says Manuel Seckel, scientist at the IZM. "Furthermore, components can be positioned on it just as precisely as on a standard board thanks to the stability of the stretchable substrate during processing. This stands in contrast to textile-based electronics, where one can expect an offset of up to five millimeters over a half-meter area." However, the researchers had to overcome a number of challenges to achieve the high level of accuracy required. One of these was how to handle and process the polyurethane. "As with stretch fabric, PU PCBs are hard to machine manufacture because they tend to change shape. To counter this, we developed a support system on which we place the PU boards and machine process them before removing the support once more," explains Seckel. The method is currently being tested by various industrial concerns.

The example of the romper suit is just one of many potential applications for flexible circuit boards. For instance, the technology could also be used to provide subtle lighting in the roof lining of cars – "stars" on the car roof, for example. Equally, it could be set to work in the pressure bandages applied to burn wounds. Here, PU plasters equipped with integrated sensors would help nurses find the optimal placement for the bandage.

Using plasters to inspect kidney function

The stretchable circuit board is also the basis for a plaster being developed by medical scientists from the University of Heidelberg in collaboration with the Fraunhofer researchers. In future, doctors will be able to use this plaster to test the kidney function of their patients. Up to now, the procedure has involved injecting a substance that only

the kidney is able to break down, and then taking blood samples roughly every 30 minutes over a three-hour period. If a kidney is healthy, it will almost completely break down the substance within three hours; if it is diseased, it will only manage a slow reduction in concentration. Equipped with a PU circuit board plaster, a blue LED and a detector, in future doctors will be able to spare patients a lot of jabbing – and examine them with much more precision. As in the standard procedure, the investigation begins with the doctor injecting a substance, in this case an organic colorant. The blue LED causes this colorant to fluoresce, making it glow, a development in turn picked up by the detector located in the plaster. As the natural colorant is broken down by the kidney, the concentration of fluorescent radiation also decreases. "The plaster allows doctors to continually monitor the concentration of the test substance, giving them a more accurate diagnosis than the standard check. In addition, the costs of the test can be reduced by up to 60 per cent," says Seckel. Already, there are plans for clinical trials, though it will be three to five years before the plaster can be used for kidney testing and make life easier for both doctors and patients.



Fitted to a romper suit, the stretchable printed circuit board monitors infants' breathing.
(© VERHAERT Masters in Innovation®) | Picture in color and printing quality: www.fraunhofer.de/press

Smart search engines for news videos

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Anyone who has visited one of the big online video portals or TV broadcasters' media libraries to search for a video clip is already familiar with the search engines tasked with seeking out and flagging video footage. However, these engines have their weaknesses. Their results are based on automatic search algorithms that often go by text-based information alone. Although they can be used to locate and identify videos, a comparison of individual sequences is still very difficult. To make search engines even smarter, the Fraunhofer Institute for Digital Media Technology IDMT in Ilmenau has developed a piece of software called "NewsHistory" that will now make full use of user knowledge as well. Researchers will be presenting an initial demonstration version of the smart video search engine at the CeBIT trade fair in Hannover from March 5-9, 2013 (Hall 9, Booth E08).

Technology learns from users

"NewsHistory provides users with search algorithms, a data model and a web-based user interface so that they can locate identical sequences within various news videos," explains Patrick Aichroth from Fraunhofer IDMT. He is responsible for coordinating the institute's R&D work within the EU's CUBRIK project. Here, researchers are harnessing user knowledge to optimize and extend the capabilities of automated analysis techniques. "The search engine learns from each individual user, allowing it to keep improving search results. Not only does this improve the quality of results, but the resources needed to undertake the analysis are also cut down," Aichroth continues.

NewsHistory allows each user to add additional information to the results generated by the search engine, including production and broadcast date, sources and keywords for videos. It is also possible to rate the results. Finally, the user's search itself is a source of information, providing data that is incorporated into the search engine; the metadata of a newly uploaded video, for instance, passes into the database.

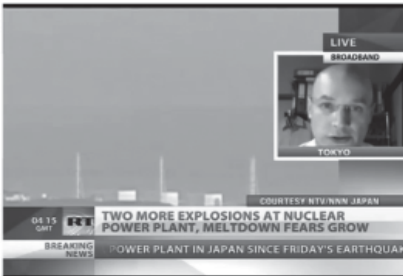
"Comparing digital video data online or within video databases is very complex," explains Christian Weigel from the Audio-Visual Systems research group at the IDMT. "Videos that share the same content have for the most part been edited, meaning that they are scaled and encoded in a variety of formats. Also, search engines are often unable to distinguish images cropped from a larger picture, lower thirds or the zoom shots so popular with US news channels."

The demonstration version being presented at CeBIT will investigate how a selection of TV channels have made use of film footage, changed its form and broadcast it. The user interface displays commonalities and appraises them in graphic form. The search itself is conducted either by inputting text or by directly uploading individual video sequences. The researchers' aim is to make the software sufficiently robust that it could

also be used in the future to compare the multimedia content found on big online media portals. The scientists do not imagine archivists or journalists will be the only users. "NewsHistory is of particular interest to media and market researchers, say if they want to assess the televised political duels coming up this year," concludes Weigel.

Reference

Fukushima_nuclear_reactor_radiation_exposure_How_far_will_this_go_RT




TIMECODE	00:03:42:14
FRAME	5564
SPEED	1 x

PLAYING SEGMENT 2 | 5564 - 5846

Comparison

30km_no-fly_zone_over_Fukushima_meltdown_fears_as_radiation_leak_confirmed_RT



TIMECODE	00:00:24:01
FRAME	601
SPEED	1 x

PLAYING SEGMENT 2 | 601 - 883

NewsHistory makes the most of user knowledge, searching through video databases to find video sequences with identical content. (© Fraunhofer IDMT) | Picture in color and printing quality: www.fraunhofer.de/press

Giant tobacco plants that stay young forever

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The life of tobacco plants is short. They grow for around three to four months, followed by flowering and then die. Their size is also limited, with plants only growing to about one-and-a-half to two meters tall. Now, researchers at the Fraunhofer Institute for Molecular Biology and Applied Ecology IME in Münster have located the tobacco plant's very own fountain of youth, which means they can keep it forever young. The Münster-based researchers discovered a genetic switch which can prevent the plants from change blooming to flowering. This also averts the plants' early change demise to senescence – and suppresses the factor that halts growth. "The first of our tobacco plants is now almost eight years old but it still just keeps on growing and growing," says Professor Dirk Prüfer, head of the Department of Functional and Applied Genomics at the IME. "Although we regularly cut it, it's six-and-a-half meters tall. If our greenhouse were a bit higher, it would probably be even bigger. Its stem is already ten centimeters in diameter." Whereas in normal tobacco plants the leaves, which grow from the bottom of the stem, soon turn yellow and drop off, the IME plant's leaves stay healthy and green. This is why the scientists have christened their modified plant species "forever young".

But what exactly do researchers do to give the plants eternal youth and make them capable of unbounded growth? "We modify the expression of a certain gene – or rather, the information contained within it – so that the plant's flowering is delayed," explains Prüfer. Researchers then insert the modified gene back into the plant using a bacterium. The role of the bacterium is to act as a sort of shuttle service for the modified gene.

Producing more biomass

The principle is transferable and could be used on other kinds of plants; at the moment, the scientists are working also on potato plants on behalf of a Japanese chemical company. They use their knowledge to get crops to yield a far greater amount of biomass. In the case of potatoes, this means a great deal more starch. "If we want to guarantee security of supply for foodstuffs and plant-based raw materials, the yield per hectare will have to double by 2050, claims the German Bioeconomy Council. This new technology brings us a great deal nearer to that target," reckons Prüfer. "However, our method is only likely to deliver success as long as the flowers of the plant in question play no significant role – sugar beet, for instance. It would make no sense to use the technique on rapeseed." Preventing plants from flowering presents a significant advantage, in that no flowering means no production of seeds or pollen. As a result, plants have no way of reproducing, which means they cannot spread into the environment in an unplanned way.

In the future, the researchers want to go further and be able to disable plants' growth limits using chemical mutagenesis as well – that is to say, using normal growing techniques. This process involves using chemical additives to bring about changes in a seed's DNA sequence. The advantage is that a plant grown in this way would no longer be genetically modified but simply a plant grown using standard techniques. "But in order to be able to do that, we first need to gain a better understanding of the deregulation of genes," says Prüfer, who hopes cultivation experiments might begin next year. Then perhaps normal plants will be in a position to grow tall, too.



Dirk Prüfer in the greenhouse with colleagues Gundula Noll (right) and Lena Harig (left) along with their tobacco plants. (© Fraunhofer IME) | Picture in color and printing quality: www.fraunhofer.de/press

Noise protection – multifunctional and aesthetical

RESEARCH NEWS

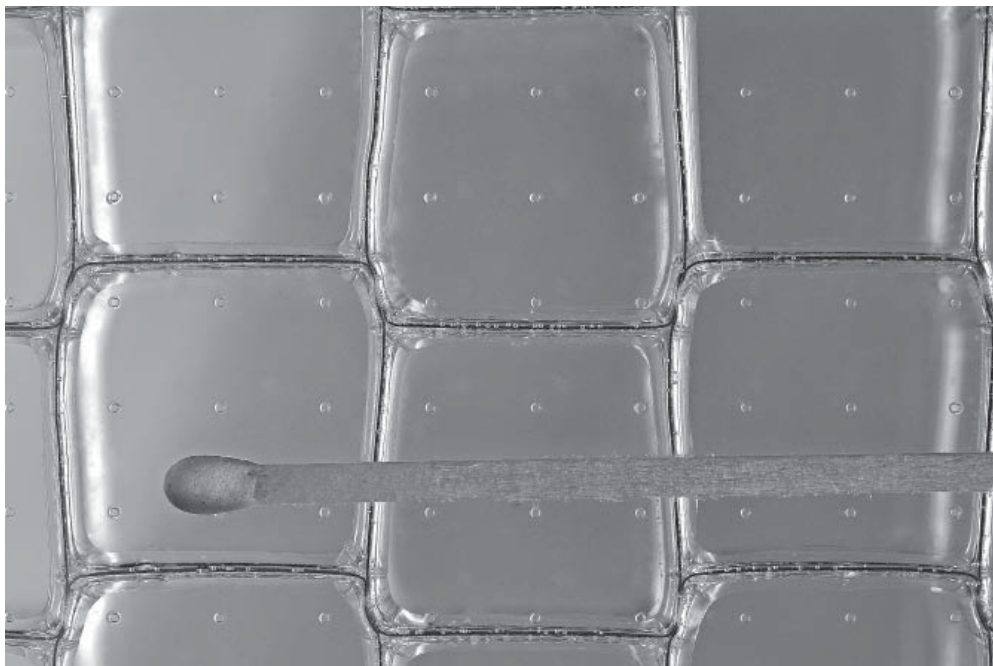
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Too much noise causes illness. This is as an undisputed fact nowadays, and yet we're still constantly assailed by noise as we go about our daily lives, be it from traffic or voices in large open-plan offices. Noise pollution can be reduced with the help of structural solutions; we've all seen noise barriers along busy roads and train lines, and there are special acoustic structural components, so-called sound absorbers, which are used inside buildings to keep noise levels down. But there's a problem. The construction components used up until now may well be effective at reducing noise, but they are not often very functional. Architects who incorporate soundproofing measures into their designs often complain about the inflexibility of modern materials. Limiting factors that affect the choice of material include weight, fire resistance or the hygienic requirements involved when designing large-scale kitchens or laboratories. After all there's also an aesthetic aspect; hardly anyone would say that a solid concrete wall along a road was attractive.

Scientists at the Fraunhofer Institute for Building Physics IBP are working on new solutions. "One of the main things we are focusing on developing is microperforated construction components. This technology is suitable for all types of material and enables the production of multifunctional, visually appealing sound absorbers that can be used for a flexible range of applications," explains Prof. Dr. Philip Leistner, acting institute director and head of the acoustics department at the IBP. Microperforated absorbers consist of membranes or sheets that have been perforated with a multitude of tiny holes or slits. When sound waves strike the surface as oscillating air molecules, friction is generated between the air in motion and the edge of the miniscule openings. It is this loss of energy that results in the sound being absorbed. The only prerequisite is that there is an air chamber located behind the openings, to allow the molecules to continue oscillating once they have passed through, as otherwise the sound would simply be reflected. Depending on the material, the holes are drilled, punched or pricked. "Above all, it's a question of cost efficiency," explains Prof. Leistner. "When it comes to ensuring the manufacturing process is cost-effective, it's important to realize that not all methods are equally well suited for every material." For it goes without saying that despite all the advantages they offer, sound absorbers must also remain affordable. Stuttgart staff and their industrial partners have already worked together to develop a whole generation of market-ready microperforated acoustic construction components. The technology means that, for the first time, it is possible to make sound absorbers that are both transparent and translucent. When mounted onto building façades or as noise barriers at the roadside, these materials have the desired effect without detracting from the landscape, and they can also be superbly integrated into the interior architecture of buildings.

Elastic surfaces for hygiene-sensitive areas

New additions to the sound absorber family are expected thanks to the latest developments at the IBP. Scientists there are working on elastic surfaces that are made of tubes arranged side by side, with microscopically small spaces in between. "It's a bit like having a brush with bristles that are enhanced by little extra attachments at the ends – only much denser," explains Prof. Leistner. Such a pliable surface means even micro-holes can be cleaned easily, making it a material that is particularly suitable for use in hygiene-sensitive areas. Extrusion technology has proved especially cost-effective for large-scale applications. This method produces a two-dimensional surface profile with micro-slits, air chambers and base plate by pressing materials such as plastic or aluminum through a shaped nozzle. In the same way as with window and façade profiles, this creates finished, one-piece absorber components that come off the production line as a continuous length of material, eradicating the need for complicated mounting procedures which proved often more expensive than the material itself. Fraunhofer scientists will be presenting prototypes of these new developments alongside tried and tested solutions at the BAU 2013 construction trade fair from January 14-19 in Munich (Hall C2, Booth 131/135).



Self-supporting microperforated honeycombs adapt to a variety of uses and blend in well with the overall architectural concept. (© Fraunhofer IBP) | Picture in color and printing quality: www.fraunhofer.de/press

Physio for the home

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Though the skier glides skillfully across the snow-covered landscape, still he stumbles on an icy section of the piste and loses his balance, ending his well-earned winter break in a hospital bed. After the operation, physiotherapy is supposed to help restore mobility. This demands considerable patience and perseverance on the part of the patient. Many people with these sorts of injuries would find it easier to do the exercises at home rather than hanging around the rehabilitation clinic for weeks on end. It's also important that patients continue to exercise at home following a lengthy stay in hospital.

A new technology has been designed to give future patients added motivation to do their exercises, allowing them to perform physiotherapy exercises at home or when out and about – during breaks at work, for instance. Experts call this telerehabilitation. Underpinning this is a technology developed by researchers at the Fraunhofer Institute for Open Communication Systems FOKUS in Berlin, consisting of an exercise editor, a physio box and a mobile sensor unit that connects to a smartphone. The therapist uses the exercise editor to work up a training program tailored to the individual patient, increasing the intensity from week to week. The patient can then run the program at home using the physio box, a sort of mini-PC for televisions. The small computer boasts internet connectivity, a camera and a microphone. Exercise routines are displayed on the TV screen for the patient to copy. The physio box analyzes the data recorded by the camera as the patient does the exercises. Beforehand, software is used to map each patient's bodily characteristics in 3D and translate them into a biomechanical computer model. Once the data has been interpreted, the box sends it via the internet to the rehabilitation center, where the therapist sees how the patient is progressing and can adapt the exercises accordingly.

Mobile unit to measure movement and vital signs

Alongside measurements of movements, therapists need to know their patients' vital signs – in other words pulse, oxygen saturation levels and, in some cases, readings from an electrocardiogram. This allows them not only to assess whether the patient is performing exercises correctly but also how much of a strain they are. This is particularly important when dealing with people who have a cardiovascular disease. "In light of this, we also developed a mobile unit," says Dr. Michael John, project manager at FOKUS. "Sensors placed in a chest strap, watch or walking stick measure vital signs like pulse, blood pressure or the quality of the patient's movement, sending the data to a smartphone." The therapist can set threshold values using the exercise editor; for example, if a patient's pulse reaches a level that exceeds the limit set for them, a warning signal is emitted.

On the one hand, the mobile unit serves to complement the physio box, but it is also supposed to help patients in future to do their exercises while on the move – out

walking or during office breaks, perhaps. "We're working on how to get the mobile unit to analyze the patient's quality of movement as well. To do this, we're using motion tracking sensors that analyze limb movements in relation to each other and in terms of absolute position," explains John. The researchers are also currently working on a transmission standard for movement measurement data, as well as on how to standardize these values so that they can be read by a variety of devices. There is already a standard, ISO 11073, for data relating to the vital signs. This specifies how to transmit data between devices, thus ensuring that data can be transferred between sensors, smartphones and medical devices from a variety of manufacturers without any problems. "We're in the process of developing a similar standard for movement measurement data, in collaboration with doctors and therapists," says John.

One of the researchers' priorities when developing each aspect of the new technology was to take into account the needs of patients and physiotherapists as much as possible. As a result, all three components – the exercise editor, the physio box and the mobile unit – were given to patients and therapists for testing in the course of numerous preliminary studies, and modified accordingly. A field test involving a larger group of patients is now due to follow in February 2013, and the system could then be ready for use beginning in summer 2013.



Thanks to a new technology developed at Fraunhofer FOKUS, patients will be able to do their physiotherapy exercises in their own homes. (© Fraunhofer FOKUS/Matthias Heyde) | Picture in color and printing quality: www.fraunhofer.de/press

Rapid diagnosis in a tissue

Winter time is the peak season for colds. Your nose is blocked, your throat scratchy, your forehead hot – but is it just a cold or in fact a 'flu virus? What medication will actually help? Often, antibiotics are prescribed as soon as there is any suspicion of an infection, since doctors are not always able to differentiate between bacterial and viral infections right away. There is as yet no high-speed diagnostic tool for medical centers to help doctors select the most effective medication. In light of this, the "Lab in a Hankie – Impulse Centre for Integrated Bioanalysis" project (www.taschentuchlabor.de) has set itself the target of developing a diagnostic system that will allow the immediate identification of relevant pathogens, whether in medical centers, facilities that must comply with rigorous hygiene standards such as kitchens or hospitals, or even in the home.

Researchers from the Fraunhofer Institute for Biomedical Engineering IBMT in Potsdam are coordinating the project, which is sponsored by Germany's Federal Ministry of Education and Research via its program for promoting high-level research and innovation in the new Länder. Over 30 partners from 14 different institutions are taking part. More specifically, researchers envision building molecular structures designed to detect pathogens into the polymers used in everyday items – such as tissues – along with a signaling system visible to the naked eye. The project is the only initiative of its kind in the world to bring together polymer and infection research.

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Replacing scarce and expensive raw materials

Some chemical elements are very difficult to obtain, yet remain pivotal to the performance of a large number of products. Let us take two examples. First, flat TFT screens' impressive, high-quality displays rely on transparent contact electrodes to ensure the flow of current across the surface of the screen. At present, the best material for this is indium tin oxide, a material also needed in the production of solar cells. This contains the rare and consequently expensive element indium. Second, to produce hard magnets certain rare earth elements are needed. These are now almost exclusively mined in China and the supply is occasionally restricted intentionally.

Researchers at the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg are now able to suggest specific ways to replace such materials. The team of ten led by Prof. Christian Elsässer, head of the group Physical Modeling of Materials, is using computers to seek out replacement materials on an atomic scale. The scientists are

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inspired by the wide variety of crystal structures found in nature, many physical properties of which have not yet been investigated. What structures can be obtained by metallurgical synthesis of various raw materials to form a hard magnet, and how favorable are their properties? Rapid virtual testing allows the team to calculate answers for a great variety of different combinations and then to suggest promising replacement materials. In collaboration with partners, who manufacture these new materials and experiment on them to test their properties, the material's composition is optimized to meet functional requirements until a final patentable and market-ready product is obtained.

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Cleaning with a carbon dioxide brush

Sensitive medical devices, clock movements, lenses, optical fibers, and IT and server components all require regular cleaning. Scientists at the Fraunhofer Institute for Production Systems and Design Technology IPK in Berlin have collaborated with Cryo-Snow GmbH to develop the CO₂ brush, a mobile, handheld tool suitable for use in clean rooms that removes even the finest impurities from surfaces using carbon dioxide.

The device uses CO₂ snow blasting, whereby the surface that is to be cleaned is sprayed with a mixture of CO₂ as snow and as a gas. Since the blast medium is not abrasive, components are cleaned gently and without damage to the surface. This makes it possible to clean even dust, mold or biocide blooms from sensitive cultural assets. The CO₂ brush is already available as a prototype. Its distinctive feature is that the user can precisely control its cleaning performance with the hand holding the tool, leaving the other hand free to move the unclean component into the desired position. The tool works without the use of compressed air; it simply connects to a CO₂ dip tube bottle containing liquid carbon dioxide.

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