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RESEARCH NEWS

04 | 2013 ||

1 Regaining proper hearing at last

Around 17 million people in Germany suffer from impaired hearing. For many of them, their hearing is so damaged that a standard hearing aid is no longer enough. A new device will improve patients' hearing and can be implanted during outpatient surgery.

2 A longer life for lithium-sulfur batteries

Electric cars have still got it tough in the German marketplace. They are too expensive and their range is too short. This is an opportune time for a breakthrough in efficient and low-cost lithium-sulfur batteries.

3 Promising stem cell therapy for leukemia patients

Leukemia patients receive a bone marrow transplant, which allows them to build a "new" immune system. However, this immune system not only attacks cancer cells but healthy tissue too. Special antibodies will be used to protect healthy tissue in future.

4 Surveying roads at 100 km/h

Germany's road network has a hard time dealing with wind and weather, tires and steel. Until now, however, surveying the damage caused to asphalt and concrete was laborious and expensive. A new laser scanner is cheaper, faster and more precise.

5 Finding instead of searching

It is easy to lose track of things in large storage facilities but not at the wind turbine manufacturer Enercon's facility in Magdeburg though, where a positioning system with digital inventory management increases transparency and expedites processes.

6 Embedding photovoltaic modules more quickly

The market for solar modules is highly competitive. For this reason, companies must save on costs, such as by using a new process. It embeds the cells twice as fast into their protective plastic sheathing – and therefore saves time and money.

7 New information services quickly

Be it Smartphone apps, monitoring the temperature of food stuffs or help against product piracy, setting up new services is costly. In the future, the NSEB service engineering platform intends to simplify that.

8 Newsflash

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 66 institutes and independent research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of more than 22,000, who work with an annual research budget totaling 1.9 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.

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Regaining proper hearing at last

"Sorry? I didn't catch that. Can you speak up please?" People who are hard of hearing can quickly drift into social isolation. Worse, they can also get into dangerous situations, for example when driving or crossing the road. Hearing aids are then a must for the almost one in every two people over the age of 65 in Europe whose hearing is poor. In the case of patients with severe hearing impairments, however, conventional behind-the-ear hearing aids reach the limits of their usefulness. These patients' hearing can only be helped by an implant, which amplifies sounds more effectively than conventional systems and boasts better sound quality. But here's the snag: these middle ear implants require complex operations that last several hours. The high risk and expense of the surgery mean that it is rarely performed. But scientists could soon present patients with more hopeful prospects, thanks to their work on an innovative hearing aid that is significantly easier to implant, making it affordable for large numbers of people.

The new solution is composed of three parts: a case with a microphone and battery; wireless, optical signal and energy transmission between the outer and middle ear; and an electro-acoustic transducer – the centerpiece and loudspeaker of the implant. Researchers from the Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart are developing the electro-acoustic transducer, which will be round in shape and measure approximately 1.2 millimeters. The IPA's partners in the project, which is sponsored by the Federal Ministry of Education and Research, are the University Department of Otolaryngology, Head and Neck Surgery Tübingen, the Natural and Medical Sciences Institute (NMI) at the University of Tübingen, and the hearing aid specialist auric Hörsysteme GmbH. "Our goal is to take the better sound quality of implantable hearing aids and combine it with a much simplified operation," says Dominik Kaltenbacher, engineer at IPA. "To implant our system, all surgeons have to do is make a small incision at the side of the eardrum and then fold it forward. This can be done in outpatient surgery."

Micro-actuator placed between middle and inner ear

The electro-acoustic transducer, which takes the form of a piezoelectric micro-actuator, is then placed directly at the connection between the middle and inner ear known as the "round window". From there it transmits acoustic signals to the inner ear in the form of amplified mechanical vibrations, thereby enhancing the hearing capacity of patients. "The electro-acoustic transducer works on the same principle as bending actuators," explains Kaltenbacher. "The bending elements, which are arranged in the shape of a pie, consist of a laminated composite made from piezo-ceramics and silicon. If voltage is applied, the elements bend upwards and generate a mechanical vibration. This spreads to the membrane of the round window and the inner ear, stimulating the auditory nerve."

The effect: although the round window implant is no larger than a pinhead, it can output volumes of up to 120 decibels, which is roughly the noise a jackhammer makes. "This high performance is necessary for very good speech comprehension, particularly for high-pitched sounds, which people who are severely hard of hearing find especially difficult to pick up," says the IPA researcher.

Experts are currently testing a first working prototype in the laboratory. Results have been positive to date. "The individual components of the hearing aid have all been developed. The next step is to optimize and assemble them," says Kaltenbacher. The implant must measure up to high requirements: the material must be encased so the body tolerates it and it has to remain stable over long periods – after all, hearing aid implants should last at least ten years. The optimized individual components should be ready by June of this year; testing of the overall system is planned for 2014.

Fraunhofer Institute for Manufacturing Engineering and Automation IPA | Nobelstr. 12 | 70569 Stuttgart | www.ipa.fraunhofer.de
Contact: Dipl.-Ing. Dominik Kaltenbacher | Phone +49 711 970-1193 | dominik.kaltenbacher@ipa.fraunhofer.de
Press: Axel Storz | Phone +49 711 970-3660 | axel.storz@ipa.fraunhofer.de

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A longer life for lithium-sulfur batteries

There are currently over 40 million cars on Germany's roads. Only a fraction of them are powered by electric energy – around 6,400 vehicles according to the Federal Ministry of Transport, Building and Urban Development. The comparatively short range of electric cars doesn't help their popularity, with drivers often having to start the search for a charging station after a mere 100 kilometers, not to mention the high price of the batteries, which cost several thousand euros. Remedying this situation has researchers looking at new options in developing more efficient technologies. An extremely promising avenue of research is the lithium-sulfur battery, which is significantly more powerful and less expensive than the better-known lithium-ion battery. Although their short lifespan has made them unsuitable for use in cars before now, this may be about to change in the foreseeable future.

Scientists at the Fraunhofer Institute for Material and Beam Technology IWS in Dresden have developed a new design that increases the charge cycles of lithium-sulfur batteries by a factor of seven. "During previous tests, the batteries scarcely crossed the 200-cycle mark. By means of a special combination of anode and cathode material, we have now managed to extend the lifespan of lithium-sulfur button cells to 1,400 cycles," says Dr. Holger Althues, head of the Chemical Surface Technology group at IWS, who is delighted with his team's breakthrough. The anode of the team's prototype is not made from the usual metallic lithium, but from a silicon-carbon compound instead. This compound is significantly more stable, as it changes less during each charging process than metallic lithium. The more the structure of the anode changes, the more it interacts with the liquid electrolyte, which is situated between the anode and the cathode and carries the lithium-ions. This process causes the liquid to break down into gas and solids and the battery to dry out. "In extreme cases, the anode "grows" to reach the cathode, creating a short circuit and causing the battery to stop working altogether," explains Althues.

The interplay between anode and cathode is the critical factor determining the performance and lifespan of a battery. In the lithium-sulfur model, the cathode is composed of elemental sulfur. The advantage here is that unlike cobalt – the main cathode material used in lithium-ion batteries – sulfur is available in almost unlimited quantities and is therefore cheaper. The problem remains, however, that sulfur also interacts with the liquid electrolyte, which impairs the performance of batteries and, in the worst case, causes them to lose capacity entirely. The IWS researchers are using porous carbons to slow down this process. "We have precisely altered the pores to allow the sulfur to lodge there, slowing down the rate at which it combines with the electrolyte," clarifies Althues. He and his colleagues have developed a method of manufacturing these special cathodes.

The experts at IWS measure the capacity of a battery in watt-hours per kilogram (Wh/kg). Over the long term, they expect lithium-sulfur batteries to reach an energy density of up to 600 Wh/kg. For comparison: the maximum energy density of the lithium-ion batteries currently in use is a mere 250 Wh/kg. "In the medium term, figures around the 500 Wh/kg mark are more realistic. In practical terms, this means you can drive twice as far with the same battery weight," says Althues. This of course implies that significantly lighter battery models are possible – an interesting prospect not only for automakers but for smartphone manufacturers too. After all, the overall weight of smartphones would be greatly reduced if they had lighter batteries. "Lithium-sulfur technology might even make electric flying a realistic possibility. Although such progress is still a long way off," adds Althues.

The researchers are currently working on further optimizing the material and using it in larger battery models. They are also turning their attention to suitable manufacturing methods. And with good reason, as this is the only way the technology will reach a mass market, leading to a significant increase in the number of electric cars on Germany's roads.

Roll-to-roll coating of electrodes at IWS: The scientists now have optimized the design of anode and cathode for lithium-sulfur batteries. (© Jürgen Leibmann) | Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Material and Beam Technology IWS | Winterbergstr. 28 | 01277 Dresden | www.iws.fraunhofer.de
Contact: Dr. Holger Althues | Phone +49 351 83391-3476 | holger.althues@iws.fraunhofer.de
Press: Dr. Ralf Jäckel | Phone +49 351 83391-3444 | ralf.jaeckel@iws.fraunhofer.de

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Promising stem cell therapy for leukemia patients

Not too long ago, leukemia left us with no chance. Today doctors can give patients hope by transplanting bone marrow, the starting point of a "new" immune system. These transplanted cells replace the diseased, blood-building stem cells in the bone marrow and take over their job of producing healthy blood cells, while also destroying leukemia cells. The problem is that this immune system originates from a foreign body and therefore can also attack healthy tissue in the patient. The skin, liver, and intestine are most affected by these attacks – their cells can be destroyed and the organs damaged, sometimes so severely as to cause organ failure. The medical term for this phenomenon is graft-versus-host disease (GvHD), and the scale of the problem posed by this misdirected immune response is illustrated by statistics revealing that up to 50 percent of all patients ultimately suffer from GvHD-induced damage; in up to 20 percent of cases this damage is fatal. Not to ignore the further risk: that one in five leukemia patients suffer a relapse after the transplant.

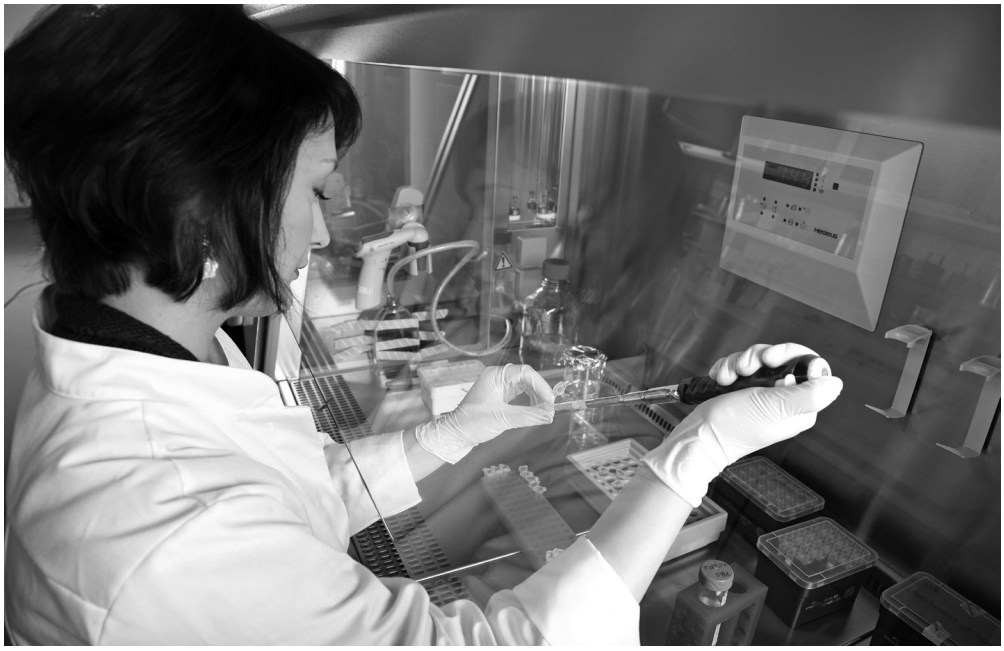
In order to combat the cancer effectively, doctors give leukemia patients chemotherapy and radiation therapy before the transplant. These treatments destroy the patient's entire blood-building system, creating space for the donor's healthy cells. Any cancer cells that might survive this treatment are identified and destroyed by the new immune cells. So that the "foreign" immune system does not turn against healthy tissue, doctors additionally give patients immunosuppressants to artificially suppress the immune system. There is a fine balance to be struck here, as immunosuppressants not only inhibit GvHD but also the desired immune response, i.e. killing off the cancer cells.

Minimizing the risk of a misdirected immune reaction

Researchers at the Fraunhofer Institute for Cell Therapy and Immunology IZI in Leipzig are investigating how to improve the situation for leukemia sufferers. "Our goal is to avoid GvHD without changing how the new immune effect acts on the tumor," says Dr. Stephan Fricke, head of the Immune Tolerance unit at the IZI and doctor at the Department of Hematology and Oncology, University Hospital Leipzig. "Our hopes are pinned on monoclonal antibodies, which specifically bind to the surface of immune cells and prevent the immune cells reacting adversely with the patient's tissue." It's particularly important that the antibodies also act on the blood stem cells to be transplanted and on all immune cells that develop from them. This allows researchers to modulate the cells in advance of transplantation, causing them to "tolerate" the patient's healthy tissue instead of attacking it. "We're then able to effectively reduce the risk of a GvHD without any side effects," explains Fricke. The antibodies do not alter the immune response against remaining cancer cells – they are still destroyed as before. This reduces the risk of leukemia coming back after the transplant.

IZI scientists are currently collaborating with their colleagues from the Translational Centre for Regenerative Medicine at the Universität Leipzig on research into the cellular foundations of these effects. What is the optimum point at which to add the antibodies to the donor bone marrow? How many antibodies should be used? Setting out to answer these questions, researchers first simulate both GvHD and the human immune system using a variety of established models. They can then determine all relevant parameters based on the simulations.

The researchers have already provided proof of principle, i.e. they were able to demonstrate that the therapy works. Now initial tests are underway on mice with a human immune system. The scientists hope that a clinical study can begin before the year is out.



Scientists are studying how antibodies can best protect the healthy tissue of leukemia patients. (© Dirk Mahler) | Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Cell Therapy and Immunology IZI | Perlickstr. 1 | 04103 Leipzig | www.izi.fraunhofer.de
Contact: Dr. Stephan Fricke | Phone +49 341 35536-2205 | stephan.fricke@izi.fraunhofer.de
Press: Jens Augustin | Phone +49 341 35536-9320 | jens.augustin@izi.fraunhofer.de

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Surveying roads at 100 km/h

Germany's roads are worth 470 billion euros. Roads in fact account for over 60 percent of the capital assets of many municipalities. But there's a risk that this value is deteriorating, as many roads now look back on 30 years of service and more. Weather and wear have taken a heavy toll on the asphalt and concrete surfaces. In spite of efforts to shift some of the transport burden to rail and water routes, 65 percent of freight traffic and 82 percent of passenger traffic is still by road. As reports of ever greater damage become more frequent, the budget for maintaining the road network steadily grows, and is now set to reach a historic high of 3.5 billion euros in 2016.

But how can the current condition and value of a road be surveyed? "One of the main factors is the quality of the surface, or more precisely, its evenness," explains Dr. Alexander Reiterer, head of the Laser Scanning research group at the Fraunhofer Institute for Physical Measurement Techniques IPM in Freiburg. He and his team have developed the first laser scanner to be approved by the Federal Highway Research Institute for measuring the evenness of roads. The technology, which has already proved its worth in railroad measurement applications, is faster, more precise, and cheaper than the previous method. A single high-resolution laser scanner is all that is needed to scan and measure the road surface across a span of four meters with a laser beam.

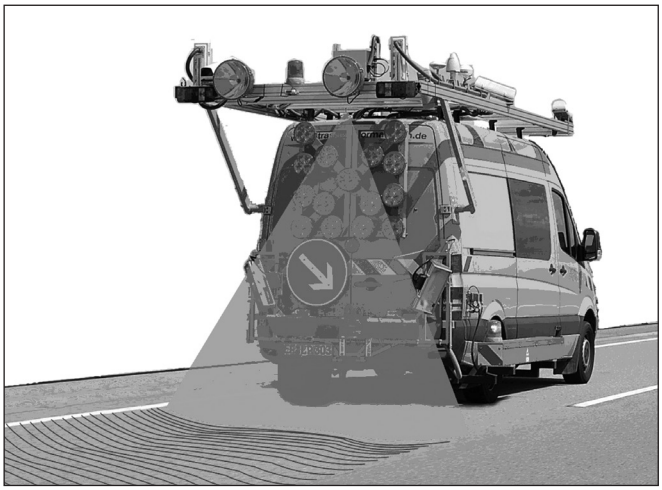
No bigger than a shoe box

The scanner, which is no bigger than a shoe box, is fixed to the measurement vehicle at a height of three meters. Rotating inside the scanner is an octagonal mirror construction, which steers the laser beam across the road perpendicular to the direction the vehicle is travelling in. An acquisition angle of 70 degrees is enough to scan the entire width of any road up to four meters wide – even from a standard vehicle. The signal is reflected from the asphalt back to the scanner, where it hits a special detector chip. The distance between the scanner and the surface of the road can be inferred from how long it takes the laser light to travel back, and measurements are accurate to between 0.15 and 0.3 millimeters. Unlike conventional measurement equipment, there is no need for broad attachments to be fitted to the vehicle. It must merely be ensured that the orientation and position of the measurement vehicle is known, which is accomplished using the Global Navigation Satellite System (GNSS) and an inertial measurement system. "Measurements are unaffected by external light conditions and can be executed at speeds of up to 100 km/h," says Reiterer.

The IPM's Pavement Profile Scanner (PPS) has already passed initial field tests. In cooperation with road surveyors from the firm LEHMANN + PARTNER GmbH, the IPM has scanned a total of 15,000 kilometers of highway and other major roads across Germany since last summer. In spring the measurement professionals will be combing

over the runways at Hamburg Airport. "The Federal Highway Research Institute laid down strict criteria before licensing the scanner on public roads: it not only had to be accurate to 0.3 millimeters, it also had to be safe for the eyes. This means that even if someone ended up looking into the laser for longer than necessary, it would not put their eyes at risk. The development partners' technology easily cleared both hurdles," reports Dr. Dirk Ebersbach, CEO of LEHMANN + PARTNER. The Erfurt-based engineering office collects data for the road information banks of federal states and municipalities and assesses the transport infrastructure in Germany. "The average service life of a road is around 30 years, and the asphalt surfacing rarely lasts more than twelve. Unevenness and damage such as ruts must be identified at an early stage in order to prevent damage to the layers beneath by means of timely repair work," adds Ebersbach.

Meanwhile, researchers are further refining the laser scanner at the IPM laboratories in Freiburg. Above all, they want to fine-tune the measuring accuracy: the prototype of the new scanner version measures at a frequency of 2 megahertz (MHz), which corresponds to two million measurements per second. The current model gets by with 1 MHz. "In future, we want to go beyond surveying the evenness of a road and also detect tiny cracks in a targeted manner, which is a better way of preventing damage. Until now, this work has been carried out using cameras," says Reiterer. In any case, there is no fear of this research object running out: the German road network alone comprises approximately 626,000 kilometers. This is just under the distance from Earth to the moon and back again!



A single laser scanner is all it takes to measure the evenness of a road four meters in breadth with a laser beam. (© LEHMANN + PARTNER GmbH) | Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Physical Measurement Techniques IPM | Heidenhofstr. 8 | 79110 Freiburg | www.ipm.fraunhofer.de
Contact: Dr. Alexander Reiterer | Phone +49 761 8857-183 | alexander.reiterer@ipm.fraunhofer.de
Press: Holger Kock | Phone +49 761 8857-129 | holger.kock@ipm.fraunhofer.de

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Finding instead of searching

Up to 50 meters long and weighing tons, the rotor blades for wind energy systems that Enercon produces in its facility in Magdeburg are truly impressive. They require the corresponding amount of space when they are stored temporarily at the plant premises of 0.5 square kilometers, waiting to be delivered. For a long time, the external storage facility was organized by telephone, information board and manual documentation. That was a source of potential errors. In addition, it cost a lot to keep the inventory records current, for example when employees moved a module around on the premises. Inventory had to be taken to maintain an overview of the warehouse.

The management of Enercon was long aware that this method required a lot of time and money. However, an alternative that avoided media failures was not in sight – not until the plant planners from Enercon met with experts from the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg, Germany, to exchange ideas. "In earlier times, there were a lot of media failures between the bulletin board, paper printouts, Excel spreadsheets and other aids in stockkeeping," recalls Tobias Kutzler, project manager at IFF. The IFF project team suggested a solution for managing the outdoor storage facility that simplified the work processes and reduced inventory management expenditures considerably.

GPS module and motion sensors simplify taking inventory

The idea: during final acceptance, a locator the size of a small paperback book is attached to each module. Using satellite data, the GPS module contained in it calculates its position down to approximately one meter. This position is transmitted by radio signals to the control center, where the module is registered in a digital map. A motion sensor detects when the part is being moved and signals the new location of the rotor blade on the grounds. Only a few mouse clicks are required to retrieve the location of the module and its production and storage history. This saves time: If, previously, taking inventory required up to two days, the time required now drops to less than 5 minutes.

Two RFID chips (one in the locator and a second one directly on the module) complete the continuous monitoring. The digital nameplates serve as a type of logbook. They are scanned with a portable reader and contain information on, for instance, module number, module type and origin. This way, the parts can still be identified even on the wind turbine construction site or later during maintenance work or repairs.

An adapter attached to the rotor blade flange, i.e. its connection, is used to mount the locator. If a storage facility employee removes the locator before delivery he or she must merely set it down upside down for a certain amount of time. The part is then removed from the stock list, without entering it in the computer.

The employees can rely on the software even when planning their storage facility. The software suggests the ideal storage location for each rotor blade so that space is utilized as efficiently as possible. Employees may accept the suggestion – or specify a suitable storage site themselves. The software recognizes that and computes the second most option. The era of countless documents and phone calls is over at Enercon in Magdeburg. "Today, there is a large touchscreen and distributed workstations on which any information can be retrieved," according to project manager Kutzler.

More than just modules can be tracked down in storage facilities with the locators. A steel manufacturer has equipped its vehicles with them to measure the stress on them when they are moving heavy steel parts. The IFF has even equipped electric cars with the modules for the Harz.EE-Mobility research project on electric vehicle networks to document the vehicles' use. Among other things the researchers identified the charge levels of the batteries with which the vehicles are driven and parked. This helps optimize the charging station infrastructure and assess the use of electrical vehicles as energy buffers in smart grids.

RFID chips in the module and in the locator make automatic continuous tracking possible. (© Dirk Mahler) | Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Factory Operation and Automation IFF | Sandtorstr. 22 | 39106 Magdeburg | www.iff.fraunhofer.de
Contact: Dipl.-Inf. Tobias Kutzler | Phone +49 391 4090-415 | tobias.kutzler@iff.fraunhofer.de
Press: René Maresch | Phone +49 391 4090-446 | rene.maresch@iff.fraunhofer.de

Fraunhofer

Embedding photovoltaic modules more quickly

Solar cells must endure a lot: snow, hot summer days, rain and humidity. To provide maximum protection to the cells, the manufacturers embed them in plastic, usually in ethylene vinyl acetate (EVA). The principle is that they laminate the cells in the first step. For this, they encase the cells in a plastic film and heat it up. Once the plastic is soft, the entire stack is pressed together in the laminator so that it flows well around the cells and encases them. This process vulcanizes the plastic – in other words, it crosslinks it (meaning that a type of rubber is created). The advantage is that the material can no longer be melted once it is in this state; it is more stable and protects the cells better against mechanical and thermal stress. For the crosslinking, the solar cell plastic stack is heated in the vacuum laminator to a temperature of up to 150 degrees Celsius; this high temperature provides the "starting signal" for the crosslinking. The processing times for the vulcanizing are rather long, however the stack of cells must remain in the laminator for about 20 minutes, sometimes even longer, driving production costs up.

Less than eight minutes for laminating

The manufacturers can counteract this cost pressure on either the process or the materials side, meaning you are able to optimize the process yourself or use better materials. Scientists from the Fraunhofer Center for Silicone Photovoltaics CSP in Halle will, from now on, support manufacturers on the process side jointly with colleagues from LANXESS: "We have modified the lamination process so that it only takes about 7 to 8 minutes instead of 20 minutes. We were therefore able to reduce the duration of the total process by more than 50 percent," says Dr. Stefan Schulze, Polymer Materials Team Leader at CSP. "In comparison to the standard process we are therefore able to laminate twice as many modules on one system, which directly positively affects the production costs per module."

The researchers were inspired by printing ink for news prints, which vulcanize in a few seconds after being exposed to a UV light. The crosslinker used by LANXESS worked in the same manner – activated by UV radiation instead of by high temperatures, it crosslinks the plastic within a few seconds while maintaining the same quality. The reason for that were the plastic films. If the usual additives are used in the plastic, then care must be taken when mixing the ingredients to always stay below the crosslinking temperature – meaning that the mixing has to be carried out very gently. For this reason, the resulting film is often not very homogenous. "However, if we crosslink the additives using UV radiation we are able to mix aggressively. We therefore achieve homogenous films and thus an improved crosslinking of the plastic," Schulze makes clear.

The researchers at CSP developed the UV crosslinking process within the Fraunhofer Innovation Cluster SolarPlastics. They are looking for answers to the following ques-

tions: How can the process be controlled? What temperatures are required? And how much radiation is required? The LANXESS employees took care of the material, meaning the composition and the type and amount of the UV crosslinker. The CSP already has a pilot plant for crosslinking where the scientists are optimizing the four parameters – the amount of radiation, the temperature, the height of the lamp and the feed rate at which the modules traverse under the UV lamps. "The process is operational," says Schulze. Interested manufacturers need not fear high costs for retrofitting their production facilities; only one UV lamp would have to be added.

Scientists are laminating a solar cell at CSP in Halle. The process is twice as fast as it used to be.
(© Fraunhofer CSP) | Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Center for Silicone Photovoltaics CSP | Walter-Hülse-Str. 1 | 06120 Halle | www.csp.fraunhofer.de
Contact: Dr. Stefan Schulze | Phone +49 345 5589-407 | stefan.schulze@csp.fraunhofer.de
Press: Jasmine Ait-Djoudi | Phone +49 345 5589-213 | jasmine.ait-djoudi@iwmh.fraunhofer.de

Fraunhofer

New information services quickly

There is a beautiful view of the Alps from the beer garden – for most vacationers a sheer delight... But which of those peaks is the Herzogstand? An app could be of help here. Developing this and other services, however, is costly, because each services has processes, humans, information systems and the respective corresponding business models behind it. It does not matter whether we are dealing with an app on a cell phone, the monitoring of food stuffs or finding counterfeit brand name products.

Researchers from the Fraunhofer Institute for Integrated Circuits IIS in Erlangen have developed a service engineering platform with which they are able to quickly and strictly develop various services. "So far there have been no reasonable procedure models and development platforms, in particular for designing information services that are based on new communication technologies" says Prof. Dr. Alexander Pflaum, head of department for Supply Chain Technologies at IIS. "We have closed this gap with our NSEB® platform." It guides the researchers through the development of the service and combines technology, business administration and information technology. "We are working closely with our partners from business and incorporate them permanently into the development process. We provide the methodology, tools and contents, our partners supply the specific information that we need for a successful development process," explains Pflaum.

The platform comprises four activity steps. In the first step (the "Quick Shot") the researchers discuss in a two-day workshop with the service provider whether the project is generally feasible and if it would be profitable economically. In the second step, which takes up approximately two to four weeks, they determine the costs and benefits of the project in detail – again in close cooperation with the service provider. In the third step, once the decision for the further development has been made the scientists include the service provider's customer to settle a number of design questions. Altogether, there are almost 40 design questions that must be answered specifically. In a final step, the researchers write down the specification with which they can realize the service.

Each of the four action steps in turn consists of eight parts. They are based on methods and design questions, such as: What does the customer expect of this service? Which technologies are to be used? How much would the customer pay for the service? The researchers determine whether there are already partial solutions in existence and which technologies are available. For this, they utilize, among other things, basic technologies that are in development at Fraunhofer. In addition, they create technology forecasts, check the economic feasibility and support all that with software.

The scientists will be able to use a new type of development center from now on to test and further develop technologies in their later applications at the L.I.N.K. Test and

Demonstration Center, which IIS will open on 26 April at the Nuremberg location where there are test and special laboratories on 1,400 square meters of hall space. In addition, there are 10,000 square meters of available open space and a secure driving stretch of 100 meters for vehicles outside. The plethora of technologies that can be tested in the L.I.N.K. ranges from innovative driver assistance systems and various logistics applications to popular tracking and wireless technologies.

Fraunhofer Institute for Integrated Circuits IIS | Am Wolfsmantel 33 | 91058 Erlangen | www.iis.fraunhofer.de
Contact: Prof. Dr. Alexander Pflaum | Phone +49 951 8631772 | alexander.pflaum@iis.fraunhofer.de
Press: Thoralf Dietz | Phone +49 9131 776-1630 | thoralf.dietz@iis.fraunhofer.de

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Enjoying the full taste of sausage, even with less salt

Most people eat too much salt. Five to six grams per day are more than sufficient. However, people usually ingest twice that amount each day. We do not, however, have a lot of room to control how much salt we ingest. The reason for this is that we consume most of the salt through processed food, such as bread, cheese or meat products. The Fraunhofer Institute for Process Engineering and Packaging IVV in Freising, Germany, is working on ways to reduce the salt content in food, without having this negatively affect the taste.

"Most of the salt we consume does not even land on our taste buds. It is simply being swallowed," explains Christian Zacherl of the IVV. He wanted to improve this, together with his colleagues from the Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI in Freiburg. "We've developed a computer-supported simulation model that simulates how the taste of food is set free in the mouth," says Dr. Martin Steinhauser of EMI. They checked the distribution of salt when chewing boiled sausage with this new method. The result is that the arrangement of the salt portions in Frankfurters or Lyoners sausages affects how the salt is tasted. "The more unevenly the salt is distributed in the sausage, the saltier it tastes," says Zacherl. Many types of sausages could do less salt without losing in taste. The researchers want to fine-tune their simulation model even further to be able to create custom-made recipes for healthy food in the future.

Fraunhofer Institute for Process Engineering and Packaging IVV
Giggenhauser Straße 35 | 85354 Freising | www.ivv.fraunhofer.de
Contact: Christian Zacherl | Phone +49 8161 491-426 | christian.zacherl@ivv.fraunhofer.de
Press: Karin Agulla | Phone +49 8161 491-120 | karin.agulla@ivv.fraunhofer.de

Algae and crustaceans in the ship's tank

The danger of introducing non-native organisms into an eco-system via a ship's ballast water has been known for a long time. Millions of tons of water from ballast tanks flow into the North Sea and the Baltic Sea every year. This way algae, mussels and crustaceans from foreign shores end up in waters off the islands of Sylt, Amrum and Fehmarn. Most of them do not survive in the new environment. But if they do, it can cause great ecological damage and cost billions of euros. To prevent this from happening in the future the International Maritime Organization (IMO) adopted the Ballast Water Management Convention in February 2004, which, however, has not yet come into force. For this reason, many ship-owners have not installed a ballast water treatment system (BWTS) on board of their vessels to this day. New legislation passed in the USA last year might get things moving again now. According to the Ballast Water Discharge Standard of the US Coast Guard, the first vessels must ensure that they are not introducing non-native species into U.S. waters from December 2013 on. This

basically means that a BWTS must be installed on board when a North American port is called. Currently, there are several BWTS available from different manufacturers, each having its own strengths and weaknesses. For this reason, it is becoming increasingly difficult to maintain an overview of the market for BWTS and identify the best system for a ship or a fleet. The Fraunhofer Center for Maritime Logistics and Services CML helps ship-owners in this selection process. Based on market studies and the ship-owner's requirements profile it identifies suitable systems. Subsequently CML offers a structured decision making approach and prepares fact-based recommendations. Thus it enables ship-owners to choose the optimum BWTS.

Fraunhofer Center for Maritime Logistics and Services CML
Schwarzenbergstraße 95D | 21073 Hamburg | www.cml.fraunhofer.de
Contact: Lutz Kretschmann | Phone +49 40 42878-6118 | lutz.kretschmann@cml.fraunhofer.de
Press: Claudia Bosse | Phone +49 40 42878-4476 | claudia.bosse@cml.fraunhofer.de

Using the waste from olives several times over

Olive oil is tasty and healthy. However, liquid and solid waste materials are created during the production process that contains polyphenols. These aromatic compounds are of natural origin, but that is one of the reasons why waste products from the olive oil industry have a considerable negative environmental impact. For this reason, the waste must be disposed of in a complicated process. Partners from research and industry examined how to utilize the residues in the "En-X-Olive" project, which is sponsored by the EU. The idea is to first extract usable substances to use them as natural antioxidants in the cosmetics or foodstuffs industry. The remaining biomass should be utilized to create energy. Scientists from the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart are checking to see if the wastes are suitable for providing biogas. Initial laboratory-scale checks show that the liquids as well as the solid residues provide valuable energy.

The residual wastes were fermented using a process developed at IGB during which the substrates are mixed optimally in the reactors during the fermentation process. Up to 720 liters of biogas were created from solid waste within 20 to 30 days per kilogram of organic dry substances, depending on the composition of the respective waste portion. For the liquid wastes, the researchers were able to prove 680 to 980 liters of biogas per kilogram of organic dry substances within 10 days. A traditional biogas facility with corn silage provides 680 liters of biogas per kilogram of organic dry substances. Even the fermentation residues can be utilized, for example, as organic fertilizer.

Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB
Nobelstr. 12 | 70569 Stuttgart | www.igb.fraunhofer.de
Contact: Prof. Dr. Dieter Bryniok | Phone +49 711 970-4211 | dieter.bryniok@igb.fraunhofer.de
Press: Claudia Vorbeck | Phone +49 711 970-4031 | claudia.vorbeck@igb.fraunhofer.de