Fraunhofer

RESEARCH NEWS

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1 Retinal scanner that fits in a purse

A person can be identified unambiguously based on his or her retina. Researchers are working to make it possible for anyone to use this technology. With the prototype of a compact, portable retinal scanner, they are one step closer to this vision.

2 Circuits and sensors direct from the printer

Printers are becoming more and more versatile. Now they can even print sensors and electronic components on 2D and 3D substrates. A new, robot-assisted production line allows the process to be automated.

3 Making light work of orbit and attitude control

Microsatellites have to be very light – every gram counts. The same applies to the gyroscopes used to sense the satellite's orientation when in orbit. A novel prototype is seven times lighter and significantly smaller than earlier systems.

4 Automated assembly of aircraft wings

Even today, aircraft wings are still assembled manually; but this process could soon be automated thanks to a novel snake-like robot capable of tightening bolts in even the most difficult-to-access cavities of the wing structure.

5 Finding the right cancer drug faster

How a cancer develops is often difficult to predict. The latest findings from Fraunhofer research help to better understand the course of the disease and to find the right personalized therapy for each patient.

6 Ceramic screws – corrosion and heat resistant

Most screws are made of steel. But high temperatures or acidic environments take their toll on this otherwise stable material. The alternative is ceramic screws. Researchers can now accurately predict their stress resistance.

7 Lasers and plasma: a powerful team

Miniscule microstructures can be embedded in materials with laser beams. But a lot of energy is needed for this when it comes to transparent materials like glass. So, researchers sought out a more efficient solution: they combined the laser with a plasma beam.

8 Newsflash

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 67 Fraunhofer Institutes and research units at over 40 different locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of around 23,000, who work with an annual research budget totaling 2 billion euros. More than 70 percent of this sum is generated through contract research on behalf of industry and publicly funded research projects. Branches in the Americas and Asia serve to promote international cooperation.

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Retinal scanner that fits in a purse

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The retina lets us see. However, it also reveals who we are. The blood vessel pattern of the retina is a biometric feature that is different in each human being. Using special eye scanners, a person could give proof of identity safely, securely and unambiguously while on the go. For example, in order to conduct bank transactions, to pay at the supermarket cash register or to unlock the car. However these devices are much too large and cumbersome for mobile use.

Scientists from the Dresden-based Fraunhofer Institute for Photonic Microsystems IPMS will be demonstrating the prototype of a retinal scanner that is small, ergonomically correct for the human hand and suitable for those who wear eyeglasses at Optatec, the international trade show for optical technologies which takes place from May 20 to 22 in Frankfurt on the Main (Hall 3, Booth D50) “Based on our research, this device is unique with respect to its compactness,” says Dr. Uwe Schelinski, group manager of Systems Integration at IPMS. Researchers housed the optical components needed to image the retina within a volume of about twelve-by-nine-by-six centimeters. These components include, for example, the infrared laser, the ocular and the MEMS-scanninng mirror (MEMS=Micro-Electro-Mechanical System). Above all, the latter has helped the scientists to put the optical system into such a compact space.

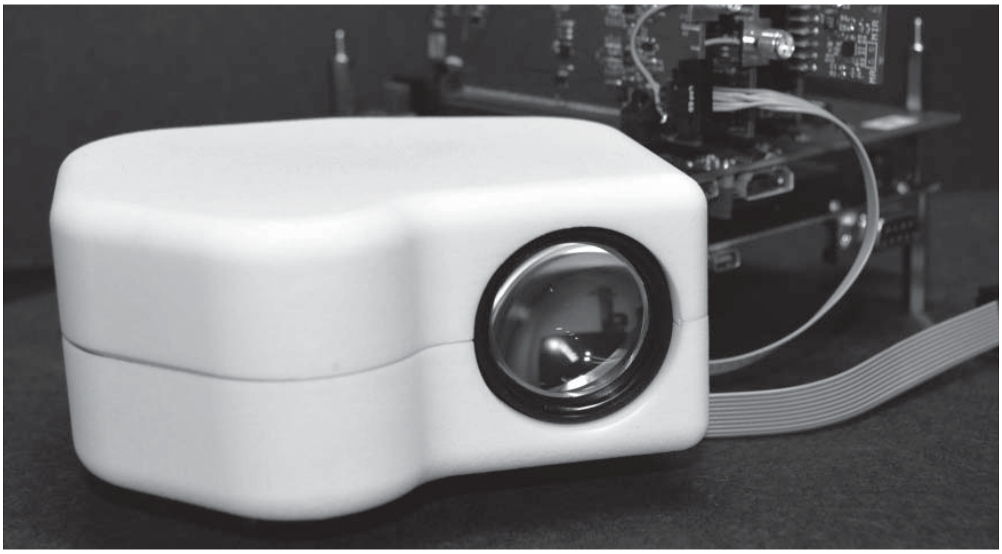
Unique pattern - comparable to a fingerprint

The silicon-based microelectronic components are as small as microchips. They deflect the optically-safe laser beam in a way that makes it possible to scan the retina in a targeted manner and allow the built-in optical instruments to capture an image of the retinal surface from the reflected laser beams. Since the blood vessels of the retina reflect less light than the surrounding photo-receptors, their pattern can be mapped in a graphically distinct way and compared with one of its owner that was previously stored. This pattern is uniquely individual to each human being, just like a fingerprint, the iris, the facial features or the voice, and proves his or her identity.

The portable retinal scanner is the result of the MARS research project sponsored by the BMBF. “MARS” stands for “Mobile Authentication via Retina Scanner.” The system is already mobile – at least, the optical components – thanks to its size. By the end of the project (in December 2014) the scientists also want to have integrated the electronics in such manner that the device is only minimally larger. Concurrently, the last phase of the MARS project deals with improving our understanding of the technology through experimentation, and with honing the valuation software. The Dresden-based scientists are supported by their colleagues at the Fraunhofer Institute for Systems and Innovation Research ISI in Freiburg. The innovation researchers are responsible on the project for ergonomics, acceptance and the legal aspects of the technology. Other partners include optical and electronics manufacturers, software firms, suppliers of biometric products, security companies and universities.

“It’s still a long way until we can integrate the technology into a smartphone. Another possibility would also be small accessory modules that communicate with the smartphone via Bluetooth, NFC or WLAN. Perhaps that is also the more prudent option in the first stage, since smartphones are still too unsecure,” states Schelinski. From his viewpoint, the technology has two essential advantages compared to stationary solutions: “First, the scans remain on the device and do not land in a database. Second, I am more willing to scan myself with my own device than with a permanently installed third party system.” The idea behind this: it is not the retinal comparison itself that is necessary in order to use applications. In fact the device – either the smartphone or the portable scanner – must unambiguously identify the respective owner. If that is the case, then this device itself is the key to access a bank acount, to unlock the car, etc. “Before the technology can conquer the market, we have to build it even more compactly. Our prototype is an important milestone on this path,” says Schelinski.

The scientist, together with his colleagues, will unveil the prototype to the public for the first time at Optatec. Visitors can gain an impression of the compactness of the little handbag-scanner, and get a live demonstration of how the system operates.



Still no smartphone, but quite handy already: the approximately 650 cubic centimeter Fraunhofer IPMS retinal scanner. The researchers display their technology at Optatec 2014.
(© Fraunhofer IPMS) | Picture in color and printing quality: www.fraunhofer.de/press

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Circuits and sensors direct from the printer

RESEARCH NEWS
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These days, no office is complete without a printer. But digital printing technologies also play an important role in microelectronics, microsystems engineering and sensor systems. Researchers at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM in Bremen use various printing methods to produce electronic components and sensors. The tiny resistors, transistors, circuit paths and capacitors are first designed on screen and then deposited directly onto two- and three-dimensional substrates, for instance circuit boards. Instead of the usual paper inks, the scientists use what are known as "functional inks" – electronic materials in liquid or paste form. The range of potential uses for printed electronics is wide – from the electronic circuits in digital thermometers to flexible sheets of solar cells and smart packaging with built-in sensors. To automate the process of applying printed electronics to components with flat and three-dimensional surfaces, the IFAM scientists have set up a robot-assisted production line that allows different printing methods to be combined in a single run. Modules for silk-screen, inkjet, dispenser, and aerosol-jet printing are integrated in the production unit. "The production line with its central robotic unit, component feeders, printing systems and heat treatment furnaces enables us to functionalize surfaces on a near-industrial scale," says Dr. Volker Zöllmer, head of the Functional Structures department at IFAM.

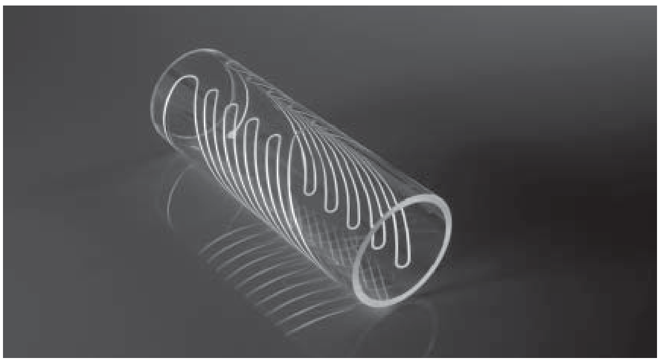
The availability of different technologies in one system makes it possible to print structures of different surface areas, widths, and thicknesses on the substrate. Aerosol-jet printing, for instance, enables the researchers to deposit extremely fine structures with a width of only 10 micrometers onto the component. In this non-contact process, the conductive ink is transformed into an aerosol using compressed air (pneumatic spraying), and then fed to the print head through a fine tube. The print head focuses the aerosol jet on the surface of the substrate, which doesn't necessarily have to be flat or smooth – even curved surfaces can be printed on using this method. It is also possible to vary the thickness of the printed features and create multilayer structures. "For example, as well as laying down circuits on a circuit board, we can also provide it with a corrosion-resistant coating," says Zöllmer.

So how exactly does this printing process work? After the control software has been programmed for the desired end product, by defining the printing methods required and the order in which they are to be executed, the robot picks up the substrate, for instance a bare circuit board, and dispatches it to the first printing station. If the task requires integrating 200-micrometer-wide circuit paths in the substrate, it is first sent to the dispenser, a piezoelectric dosing system. The dispenser contains a valve that allows the precise volume and droplet size of the viscous medium – e.g. an electrically conductive adhesive – to be applied. If the conductor is to be connected to a sensor, the circuit board is then routed to the aerosol-jet printer. This high-resolution device prints the sensors. The circuit board then passes through other printers, depending on the application, before finally undergoing heat treatment in the furnace, in order to obtain the desired performance characteristics. The system is capable of printing on substrates up to the size of a DIN-A3 sheet of paper, and can process components with a height of several centimeters.

Functionalized surfaces to order

The choice of materials that can be used as substrates or functional inks is almost unlimited. The inks employed by the IFAM specialists include metals, ceramics, electrically conductive polymers, and even biomaterials such as proteins and enzymes. Depending on the application, these media are deposited on substrates made of glass, textiles, metals, ceramic plates, and many other materials. “The new production line enables us to process a wide range of different materials and combine them in many different ways to meet the customer’s requirements. This includes designing components capable of providing entirely new functions – such as window panes with integrated sensors for measuring temperature.” Zöllmer adds. “Printed sensors can also be used to monitor building components, providing early warning of crack formation and other structural damage. They could also be useful in the car industry, where strain gages printed on aluminum surfaces by means of aerosol-jet printing could provide an early indication of material fatigue in body components.”

The robot-assisted production line also helps to shorten development lead times. In the past, to provide components with sensor functions, it was often necessary to integrate the sensors in the component after it had been manufactured – a time-consuming process. Depending on the application, the IFAM researchers can achieve the same result in a matter of seconds or minutes by printing fully functionalized components. This offers advantages to many sectors of industry, including car manufacturing and aerospace, and also microsystems engineering. “We can help industry to streamline its product development processes, by manufacturing prototypes and small batches using our production line,” says Zöllmer. The modular production line also provides scope for customers to add their own processes.



Cylinder featuring functional surfaces acting as sensors. (© Fraunhofer IFAM) | Picture in color and printing quality: www.fraunhofer.de/press

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Making light work of orbit and attitude control

RESEARCH NEWS
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When you observe the sky on a clear night, the twinkling objects you see may not only be stars but also man-made satellites. Occasionally visible from Earth, these orbiting spacecraft come in different sizes, from large telecommunications and TV satellites to the smaller scientific satellites that serve as space laboratories. The measuring instruments they carry on board send back data to researchers on the ground for use in various projects. An example is the TET satellite, which scientists are using to test the capacity of new measuring systems to withstand the inhospitable conditions of space missions. If they pass these tests, they can be incorporated in other small satellites.

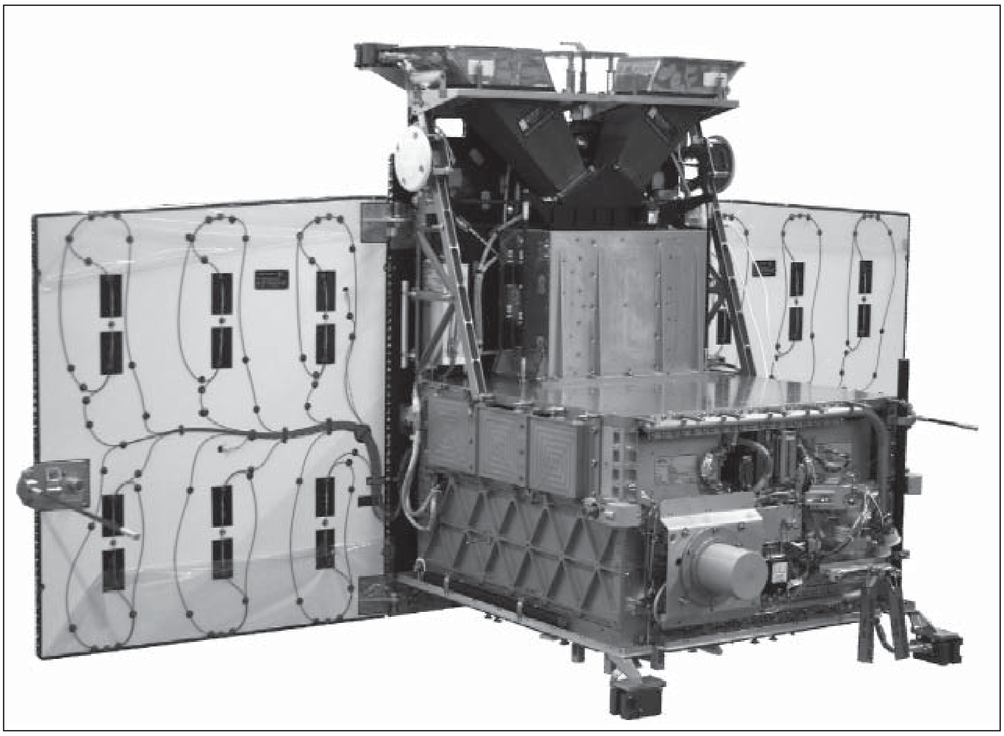
One such system is the gyroscope developed by researchers at the Fraunhofer Institute for Reliability and Microintegration IZM in Berlin in collaboration with the engineering specialists at Astro- und Feinwerktechnik Adlershof GmbH. Satellites use gyroscopic sensors to determine their orientation relative to their orbital position as a backup system if their star tracker is inoperative or if star visibility is degraded. Such attitude control systems require at least three gyroscopes, one for each direction of movement. They measure the satellite's rate of rotation and calculate its orientation on the basis of the most recent reliable data supplied by the star tracker.

The gyroscopes must be able to withstand the extreme temperature fluctuations encountered in low Earth orbit – where temperatures range between minus 40 and plus 80 degrees Celsius – without damage, and remain operable for several years despite the high solar radiation. A further requirement is that they should be as small and light as possible, because payload capacity is limited and every gram saved on the launch pad immediately translates into lower costs. Finally, the gyroscopes must be energy-efficient, because microsatellites only have a tiny solar panel to generate the power they need.

No larger than a wallet

"Our gyroscope withstands the inhospitable conditions of space, and is also significantly smaller, lighter, and consumes less energy than comparable solutions," says Michael Scheiding, managing director of Astro- und Feinwerktechnik Adlershof GmbH. Instead of the usual 7.5 kilograms, it weighs in at a little less than one kilo. And the scientists have also significantly reduced its volume. While similar devices are usually about the size of a shoe box, the new gyroscope measures just 10 by 14 by 3 centimeters, i.e. no larger than a wallet. The researchers' ultimate aim is to halve the size of the system yet again. Another advantage is that it requires approximately half as much energy as comparable devices.

How did the researchers achieve this result? To find out, it is necessary to take a look inside the fiber-optic gyroscope. Its main component is a fiber coil, a core with one to two kilometers of fiber wrapped around it. The longer the fiber, the more accurate the gyroscope. “We have reduced the length of the fiber to 400 meters, but can still obtain the same level of accuracy,” says Marcus Heimann, a researcher at IZM. “One of the things we did to achieve this was to select more efficient optical components.” The splice points between the different fibers that link the light source, the detector, and the coil have also been optimized. The scientists will be presenting their prototype at the Sensor + Test trade show in Nürnberg from June 3 to 5 (Hall 12, Booth 12-537). Visitors can test how accurately the gyroscope determines the rate of rotation by making it rotate on a turntable.



The new gyroscope could one day help a satellite bus like this with attitude detection: the platform of the approximately one-meter long TET-1 satellite. (© Astro Feinwerktechnik Adlershof GmbH) | Picture in color and printing quality: www.fraunhofer.de/press

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Automated assembly of aircraft wings

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The volume of air traffic has soared in the past few decades, and aircraft manufacturer Airbus expects to see this figure triple by 2030. On a single day, more than 1,300 take-offs and landings are handled by the flight tower at Frankfurt's international airport. This represents no less than 155,000 passengers who pass through this airport each day. To provide sufficient planes to cover this need for air transportation capacity, aircraft manufacturers will have to modernize their production processes.

Until now, aircraft assembly has involved a high proportion of manual processes, which limits production output. These processes must be automated to increase the rate of production. In certain cases this can be achieved easily, but wing assembly remains a major challenge. Why is this so? The main reason lies in the complicated internal structure of the wings, which consist of a series of hollow chambers. The only access to this space is through narrow hatches with a length of 45 centimeters and a width of 25 centimeters; this makes it extremely difficult for assembly workers to climb through these openings in order to fit the bolts that hold the parts together and seal the joints. This drilling and sealing operation has to be repeated around 3,000 times for each wingbox. This is time-consuming work that demands intensive physical effort that quickly leads to fatigue, not to mention the health risks resulting from the volatile organic compounds released by the sealing materials.

Slim, multi-jointed robot system for use in narrow spaces

Conventional industrial robots are too inflexible to pass through narrow openings. Their rigid arms are not capable of reaching the outermost regions of a workspace that extends up to five meters in length. What is needed is a slim robot with articulated arms. Researchers at the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz are currently working on an automation solution based on articulated robot arms. "The robot is equipped with articulated arms consisting of eight series-connected elements which allow them to be rotated or inclined within a very narrow radius in order to reach the furthest extremities of the wingbox cavities. That's why we often refer to the system as a snake robot," says IWU project manager Marco Breitfeld.

The tool is attached to the first in the series of eight limbs, or can be replaced by an inspection camera if required. In total, the robot arm measures 2.5 meters in length and is capable of supporting tools weighing up to 15 kilograms in addition to its own weight.

The kinematics used to drive the robot are based on a sophisticated mechanism including an innovative gear system for which a patent application has been filed. Conventional motors are not an option for the individual sections of the robot arm, due to their compact design. Breitfeld's team has therefore integrated a very small motor in each of the eight sections of the robot arm, which together are capable of generating a very high torque of up to 500 Newton-meters. Used in conjunction with a cord-and-spindle drive system, each section of the robot arm can be moved independently and turned through an angle of up to 90 degrees. "The drive concept allows this solution to be used in any situation requiring the application of high forces and torque within a limited space," Breitfeld says. "There is a need for compact automation solutions of this type in aircraft manufacturing, automobile construction, and power plant design."

The next stage in the project involves installing the 60-kilogram robot on a mobile platform or rails, allowing it to travel along the length of the wingbox and penetrate each chamber. The mobile robot platform developed by the Fraunhofer Institute for Factory Operation and Automation IFF as part of the EU-funded VALERI project would be a suitable option. At present, the IWU researchers are testing the mechanical design and control functions. A demonstration model of the robot will be presented at the Automatica trade show in Munich from June 3 to 6 (in Halle B4, Booth 228). A full version of the system equipped with an eight-part articulated robotic arm is to be created by the end of 2014.

The robot winds its way through the narrow openings inside the airfoil like a snake. Its articulated joints are so flexible that they can reach the furthermost regions of the workspace.
(© Fraunhofer IWU) | Picture in color and printing quality: www.fraunhofer.de/press

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Finding the right cancer drug faster

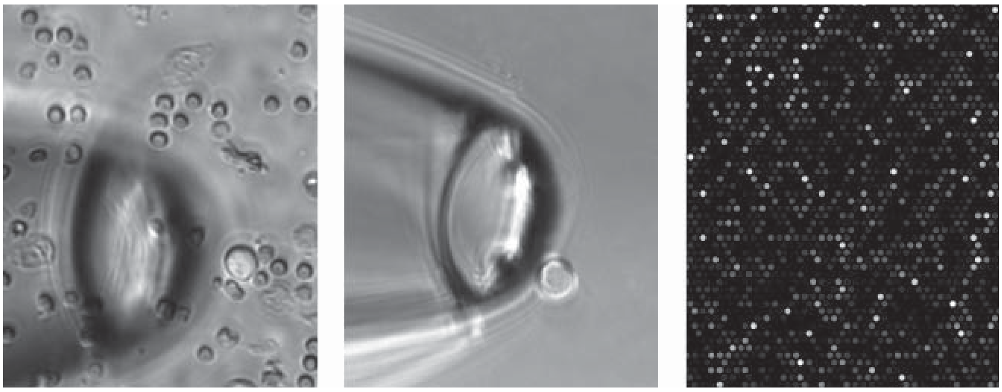
The battle against cancer is a protracted fight for sufferers. Even when a tumor can be removed by surgery, the disease is far from defeated. Tumor cells spread through the bloodstream into other organs, where they can develop into new metastases. In order to render these disseminated cells harmless, the patient must undergo postoperative chemotherapy. New approaches to treatment, for breast cancer for instance, integrate molecular genetic findings to help choose the most effective drugs for each patient. Doctors examine the genetic "fingerprint" of the primary tumor; if e. g. expression of the gene HER2 is increased, the patient receives the drug Herceptin.

Even tumors with a size of 1 to 6 millimeters can spread

Researchers at the Fraunhofer Institute for Toxicology and Experimental Medicine ITEM have discovered something astounding. "The assumption that spreading cells have the same characteristics as the primary tumor is sometimes true, but far from always," explains Prof. Christoph Klein, head of the ITEM project group "Personalized Tumor Therapy" in Regensburg. The scientist and his team found evidence that that cancer cells spread much earlier than was previously suspected. In the case of breast cancer, tumors are generally diagnosed at a size of 1-2 centimeters, but dissemination begins when the tumor is only between 1 and 6 millimeters. "At this stage of the disease, the primary tumor usually hasn't even been detected yet. Consequently, its genetic profile also remains unknown at this point in time," says Klein. Research using animal models has confirmed that the secondary tumors demonstrate different characteristics than an already palpable primary tumor. "It's clear that cancer is an evolutionary process," Klein explains. "Over the course of the disease, cells change."

In order to ensure this translates into effective, targeted treatment, the researcher believes the focus at diagnosis needs to shift away from the primary tumor and towards the spreading cells. In this regard, the Regensburg project group works on methods for detecting cells using markers and then analyzing their molecular genetic profile. In a recently published study on melanoma for instance, the researchers could show that early-stage metastases were present in the sentinel lymph nodes; these provided insightful information about characteristic cell properties. The sentinel lymph node is the first lymph node in the tumor's drainage area and therefore all disseminated tumor cells must pass through it. The study also showed a strong correlation between the number of metastatic cells in the sentinel lymph nodes and the risk of patient mortality. When this information is combined with known properties of the primary tumor, the patient's prognosis can be reliably estimated.

In February, Prof. Klein was awarded the highly reputed German Cancer Prize for his research. He hopes to contribute to a better understanding of the dynamics of cancer and align that knowledge into better treatment strategies. "Our aim is to identify the right medications for a particular patient so as to prevent the actual formation of lethal metastases," says Klein. For some patients, quite different measures than the highly toxic chemotherapy could potentially be of some help because, as the researchers have found, even cancer cells seem to be governed by Darwin's survival of the fittest rule. Once they spread to other regions of the body, cells are subject to different selection pressure than they were at the point of formation. The good news is, most cells won't survive, and therefore will never develop into secondary tumors.



The pictures show the isolation of a breast cancer cell (small circle at left and center) and at right a section of their "molecular portrait." (© Fraunhofer ITEM) | Picture in color and printing quality: www.fraunhofer.de/press

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Ceramic screws – corrosion and heat resistant

RESEARCH NEWS
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A mere second's distraction and you've stumbled over the curb. The diagnosis: compound fracture. Doctors bind the bone fragments with splints to ensure the bones knit themselves back together correctly. If metal screws are used to hold the splint in place, there is a risk of intolerance, which is why many doctors would prefer ceramic screws. Long-term implants present a similar problem. Even if something as small as one tiny screw contains metal material, it will be magnetic; this excludes all future use of computer and magnetic resonance imaging diagnostics. Outside of the hospital, ceramic screws are also a good alternative for chemical, electrical and thermal applications because they are electrically isolating and hold up well to immersion in acids and lye. Ceramic screws can also withstand temperatures over 1000 degrees Celsius, while their metallic counterparts soften at around 500 degrees Celsius. Industrial furnaces are almost entirely made of ceramic parts because of the high temperatures they must tolerate – except for the screws. "Since the weakest material limits the application, the temperature cannot be any higher than the screws can tolerate," says Christof Koplin, a researcher at the Fraunhofer Institute for Mechanics of Materials IWM. "With ceramic screws we could finally make the technologic leap to all-ceramic solutions."

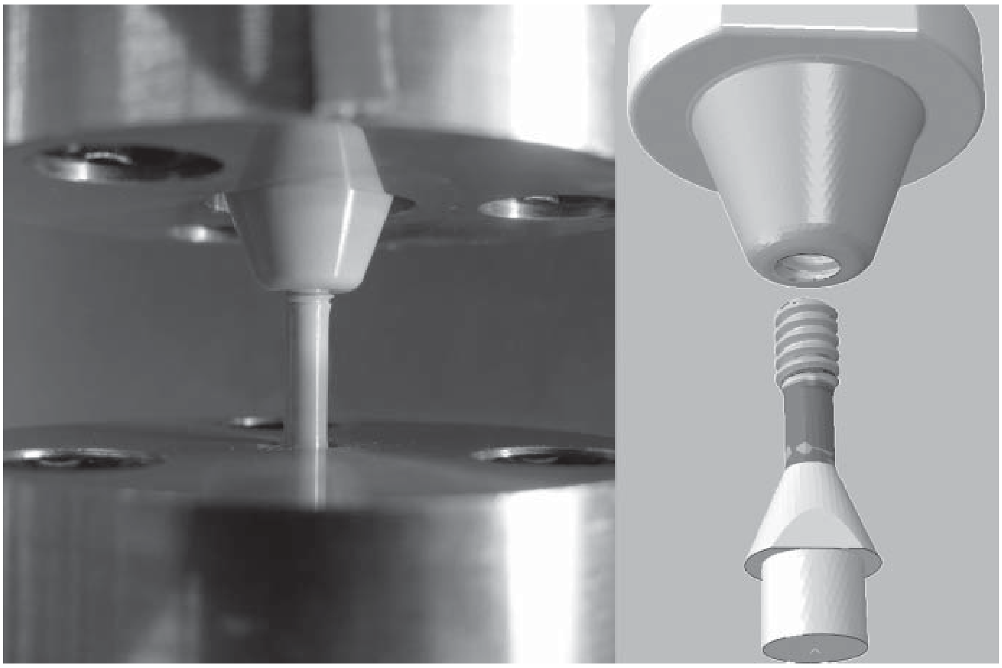
But until now manufactures have been skeptical for an understandable reason: ceramics are notoriously brittle. Although some ceramics have a load-bearing capacity close to that of steel, once the material has been processed into the final screw form, it is estimated that only about 10 to 20 percent of the original strength remains. Until now, screw manufacturers did not know exactly what load they could support.

Screw hardness put to the test

Using a screw test rig and simulations, researchers at IWM in Freiburg and their colleagues at the Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden and the Institute for Machine Tools and Factory Management IWF at the Technische Universität Berlin have devoted themselves to exactly this question. "We're testing different ceramic screws and examining how much stress they can really withstand," explains Koplin. The project is funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) and the German Federation of Industrial Research Associations (AiF).

Researchers are also optimizing the screw design. The challenge is that load capacity varies greatly even among ceramic screws of the same design; while one screw can tolerate a great deal, another breaks much sooner. The load on the screws is therefore limited by the stress that the weakest among them can withstand. The ceramic's composition is the deciding factor – if the tiny grains that make up the substance bond incorrectly during manufacture, small cracks develop which can later cause the material to fail. Researchers have now optimized the manufacturing process so that such cracks no longer occur in any of the numerous process steps. “We were able to significantly reduce the range of the distribution curve and thus raise the stress resistance of the screws,” says Koplin. He sees significant room for improvement in the last process step, in which the screws receive their thread, either via injection molding or sanding. Until that has been optimized, screw manufacturers can turn to the IWM and consult the project team about what design best suits which targeted screw load capacity value and what the ideal manufacturing process should look like.

The researchers have also used the test rig to test the stress resistance of ceramic screws manufactured in their own laboratories. Their load-bearing capacity exceeds that of their steel counterparts by between 30 and 35 percent. “This is a huge leap forward,” says Koplin. “This would already be enough for many applications if the screw was a bit bigger.”



Testing the stress resistance of a newly designed ceramic swivel joint with 4 mm screw diameter: in real life on the left, virtually on the right, using computer simulation (inverse modelling). (© Fraunhofer IWM) | Picture in color and printing quality: www.fraunhofer.de/press

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Lasers and plasma: a powerful team

You can find them in cellphones, in high-quality cameras and electronic driver assistance systems: tiny optical components, made of glass, that are equipped with microstructures. As a rule, laser technology is used to insert the extremely fine structures into the glass surface. Since glass is transparent, however, laser processing becomes a real challenge: if the laser's energy density is too low, then insufficient radiation is absorbed in order to achieve the desired effect. If the power density is excessive, then undesired side effects often result – like contamination by ablation debris.

Researchers at the Fraunhofer Institute for Surface Engineering and Thin Films IST are now striking out on a completely new path: in the structuring process, they couple atmospheric pressure plasma into the laser beam. "By using this laser-plasma hybrid technology, we have succeeded in conducting the structuring using far less energy," explains Prof. Wolfgang Viöl, head of the Application Center for Plasma and Photonics at IST in Göttingen.

Plasma is known to be a reactive gas that consists of free-moving, energy-rich electrons, ions and neutral particles. If the pressure in this gas mixture roughly corresponds to that of the surrounding environment, then this reflects atmospheric pressure or normal pressure plasma. In nature, plasma appears in lightning bolts, for example. Plasma is often used today in the machining of components – to refine or to modify surfaces.

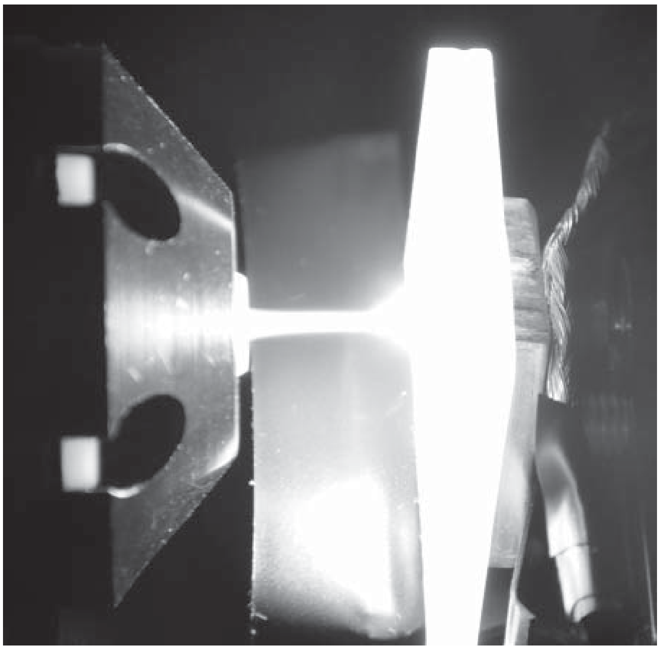
Hybrid technology for precise processing results

The combination with laser technology is new: in order to realize this process, scientists have designed a plasma source that initially delivers cold plasma, and secondly produces a very fine beam that can be coupled into the laser beam without any complications. "The effect of this plasma beam is that the laser radiation can be absorbed better, so that we can conduct the processing with relatively low laser energy," explains Prof. Viöl. The standard procedure today calls for the use of either a UV or an infrared laser for glass processing, so that the necessary absorption is achieved. Both procedures, however, have disadvantages: whereas infrared lasers are really imprecise, the operating costs with UV lasers are exorbitant. By contrast the laser/plasma hybrid technology delivers not only precise processing results, it is also economically attractive.

This new procedure had already proven itself in tests with various glasses, and a patent application has just been submitted for it. The spectrum of applications is vast: micro-optics made of glass are needed in telecommunications as much as in consumer electronics or security technology. Tiny microstructures in glasses that are not visible to the naked eye can furthermore be used as protection against plagiarism for high-grade optical components.

The researchers will exhibit a few glass prototypes that were structured with the new procedure, as well as a plasma source which can be used for processing, at this year's Optatec, the international trade show for optical technology, which takes place from May 20 to 22 in Frankfurt (Hall 3, Booth D50).

At the next stage, the Göttingen-based scientists will also extend their hybrid approach to other materials – such as metals, ceramics or synthetics. The simultaneous use of laser and plasma could also make new processing or coating processes possible – even for temperature-sensitive materials such as textiles and paper.



Fraunhofer researchers combine a laser and a plasma beam for the first time to realize microstructures to glass objects. Initial results reveal that by this approach, the production process can become more precise and economical. (© Fraunhofer IST) | Picture in color and printing quality: www.fraunhofer.de/press

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Finding work spaces and learning tools per app

In many German cities, the universities – with their attendant faculties and institutes – are disbursed throughout the entire urban region. To get from one seminar to the next, students often have to cover far distances. Many of them would love to use the time between the lectures to study – but too often, all of the workstations are taken once they reach the libraries. To optimize their studies, students additionally need access to technical books and study groups. The Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB in Karlsruhe is dedicated to this issue through the EU project called "OpenIoT" which stands for "Open Source Internet of Things (www.openiot.eu/). The goal of this project is to create an open infrastructure through which people can hold exchanges, and additionally through which objects can be networked.

To make it possible for students to search for available spaces and other learning tools – such as exercise sheets – the researchers at IOSB, working jointly with the Karlsruhe Institute of Technology KIT, recently engineered the KIT-Campus-Guide app. Through its search function, the student can specify that the work space should have a printer and WLAN access. Exercise sheets can then be sent directly to the printer and be used upon arrival at the work station. Students can reach their study group's discussion worksheets by a QR code on the learning materials, where they can post questions, obtain assistance from tutors or schedule meetings with fellow students. The spontaneous occurrence of such a study group can be supported through the connection of the social networks with the data about place, rooms and learning materials. Using the KIT-Campus-Guide, researchers illustrate how the Internet that we use today, with its social networks, can still be enhanced by the Internet of Things.

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Ceramics extend the lifespan of high-performance LEDs

When viewed at the microscopic level, ceramics consist of many small clay mineral crystals that are arranged in an orderly fashion next to each other. This makes the material an excellent heat conductor. Researchers at the Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden use this property in order to produce transparent optical ceramics for high-performance LEDs (Light Emitting Diode) from modern fluorescent materials. These very bright light sources are used, for instance, in street lighting, in the front headlights of automobiles, and in medical device technology. For all applications, it is necessary to maintain excellent light quality for as long as possible, despite high energy density and generation of heat. The scientists present new, especially high-capacity optical ceramics at Optatec in Frankfurt from May 20 to 22 (Hall 3, Booth D50).

Since an LED cannot emit white light itself by dint of physical principles, its light beams must first be conducted through an optical ceramic material. The initially blue light only turns into white light after it passes through a sliver of yellow ceramics. The researchers are capable of finishing ceramics for various optical applications – from small, laboratory sizes through to pilot series. Additional non-optical, high performance ceramics by the Dresden-based institute can be used, for example, in fuel cells, soot particle filters, artificial teeth, and hip prostheses.

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Efficient Laundry Logistics Thanks to RFID

Commercial laundries launder up to 100,000 bed sheets and hand towels every day, usually for hotels or hospitals. Each customer's laundry is handled separately, even though the washers are often not fully utilized in the process. Energy consumption could be cut by ten percent if the washer drums were loaded to maximum capacity with items from several customers. The catch: Laundry employees have to painstakingly sort the laundry afterward.

One solution to this problem is RFID tags, which are affixed to textiles and make them clearly identifiable in closed laundry bags. RFID tags have already become established for workwear. Researchers at the Fraunhofer Institute for Factory Operation and Automation IFF are working together with industry partners on solutions to get the technology accepted in flatwork. They are identifying appropriate points in the laundry process where a reader can be integrated so that really every laundry item is scanned. The wireless system has been optimized so that it also functions perfectly in environments with a lot of metal and moisture. The RFID tags have already proven their practicability in tests: They are even more durable than the laundry items themselves. At present, the researchers are working with collaborating partners on the development of a service robot that will sort soiled laundry. It will not only simplify work but also increase hygienic standards in commercial laundries.

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