

## RESEARCH NEWS

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### 1 Laser instead of drill

If the brain starts to swell after a stroke, surgery is often the only treatment option – one in which the physicians open the patient's cranial vault. Up to now, they would reach for the drill and the saw. Soon, a laser beam will cut the bone and lower the risk.

### 2 Glove shows its true colors

Security takes top priority in laboratories and in production. In the future, employees exposed to risks will only have to put on a glove in order to receive a toxic substance warning: This textile identifies poisonous substances, and points them out immediately.

### 3 OLED brings out the shine

Screens made of organic light diodes promise unfathomable possibilities. Yet high production costs often prevent their widespread use. A new kind of production saves not only costs, but also improves the radiance of the OLED.

### 4 Using cattails for insulation

A growing number of homeowners are insulating their walls in order to lower energy costs. They opt for the cheap variety, polystyrene. Yet there are environmentally-friendly alternatives: Cattails, for instance, are superbly suited as a natural insulation material.

### 5 Perfectly designed microelectronics

Microchips play an important role in industrial and household electronics. Their miniaturized circuits must not only function faultlessly but also consume as little energy as possible. Researchers are now working on making the tiny devices even more efficient.

### 6 Credit card fraudsters quickly exposed

Most people feel safe from fraudsters if their credit card is safely tucked away in their wallet. But they shouldn't: in most cases, thieves only need card numbers and information. A new software can provide more effective protection against credit card theft.

### 7 Set in the right light

Lighting plays a big role at events presenting new products, on television shows, and at concerts. Mobilight, a portable and wireless system, offers a wide range of options. And researchers have now made it even better.

### 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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## Laser instead of drill

A stroke strikes suddenly, and just as suddenly tears many of those who are stricken away from the life they are used to. If the infarction is a major one, this may cause the brain to swell. The pressure in the cranial cavity increases, perfusion to the brain diminishes and the brain suffers further damage. To protect it from contusions, the surgeon will often open the patient's cranial vault – this is referred to as a release craniotomy. Until now, surgeons cut the cranial bones mechanically, that is, with a trephine. However, that approach comes with a truly high risk to the patient: By using the trephine, the surgeon could inadvertently injure the meninges, which could then lead to meningitis and, in the worst case scenario, to death.

Researchers at the Fraunhofer Institute for Photonic Microsystems IPMS in Dresden, together with their colleagues at the Fraunhofer Institute for Laser Technology ILT and at Integrated Circuits IIS, intend to lower this risk by replacing the trephine with a high-energy femto-second laser. "Our colleagues at ILT have engineered a device that allows the surgeon to guide the laser beam and cut the cranial bone," says Dr. Thilo Sander, group manager at IPMS.

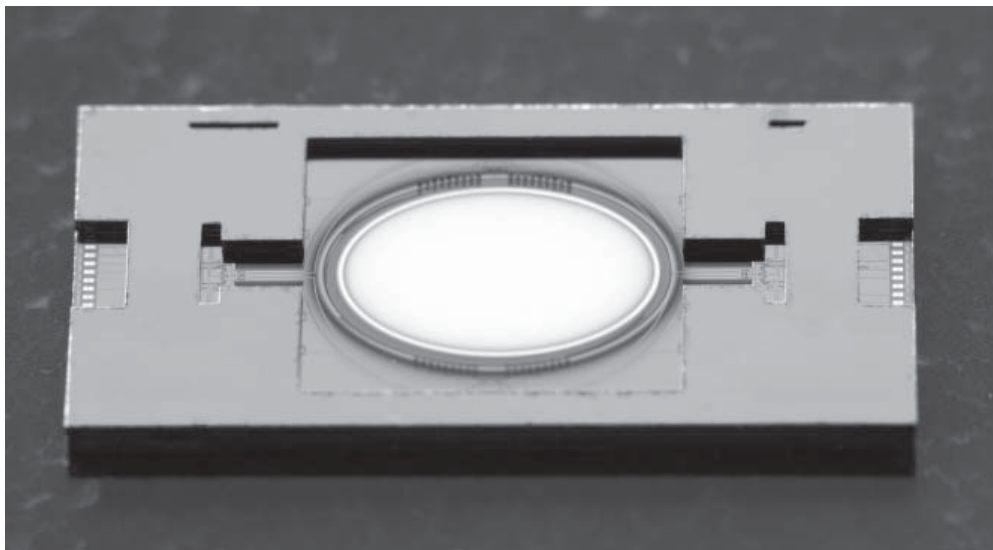
### New high-performance micro-mirror

The laser beam is fed into the hand piece through an articulated mirror arm. Its core consists of two new types of micro-mirrors that the researchers at IPMS developed. The first makes the cranial vault incision; it directs the laser beam dynamically across the cranial bones. The second adjusts any malpositioning. The special thing: The components are miniaturized, but can tolerate up to 20 watts of laser output – which is about two hundred times more than conventional micro-mirrors. These can already reach their limits at 100 milliwatts, depending on their specific design. In addition, at 5 x 7 or 6 x 8 millimeters, they are very large and thus, can also guide large diameter laser beams. By comparison: Conventional micro-mirrors measure from 1 to 3 millimeters.

How did the researchers achieve this? "Whereas the silicon panel in conventional micro-mirrors is mirrored by an aluminum layer measuring a hundred nanometers thick, we applied highly-reflective electric layers to the silicon substrate," explains Sander. Therefore, in the visible spectral range, the mirror reflects not merely 90 percent of the laser beam, like typical components, but 99.9 percent instead. Much less of the high-energy radiation penetrates into the substrate. That means the mirror "discerns" less of the laser beam and tolerates markedly greater power. The challenge for the researchers primarily lay in capturing this high power coating onto the silicon substrate, just a few micrometers thin, that is commonplace in microsystems technology. Because the researchers must apply several different layers – altogether a few micrometers thick – in order to achieve the desired reflective properties. However, a certain mechanical stress prevails in each of these layers; in addition, all layers expand at different intensities at

high temperature. As a result, the substrate becomes deformed – it arches. “This arching diminishes the optical quality of the mirror. We counterbalance this by applying this same coating on the reverse side of the substrate,” reveals Sander.

Demonstration models of the handpiece and the micro-mirror already exist. The researchers will exhibit them at the “Laser – World of Photonics” convention from May 13 to 16 in Munich (Hall B2, Booth 421). In subsequent stages of development, the scientists intend to optimize the incision performance.



**The IPMS micro-mirror measures just 6 x 8 millimeters and covers a greater surface area than conventional models. The size enables it to guide large-diameter laser beams. (© Fraunhofer IPMS)**  
| Picture in color and printing quality: [www.fraunhofer.de/press](http://www.fraunhofer.de/press)

## Glove shows its true colors

Employees in chemical production, the semiconductor industry or in laboratories are frequently exposed to harmful substances. The problem: Many of these aggressive substances are imperceptible to human senses, which makes handling them so risky. That's why there is a broad range of solutions that employers can use to protect their staff from hazardous substances – from highly sensitive measuring equipment to heat imaging cameras. Soon, this spectrum will be enhanced by one more clever solution that is easy to handle, and that dispenses with a power supply. Researchers at the Fraunhofer Research Institution for Modular Solid State Technologies EMFT in Regensburg have engineered a glove that recognizes if toxic substances are present in the surrounding air.

The protective glove is equipped with custom-made sensor materials and indicates the presence of toxic substances by changing colors. In this regard, the scientists adapted the materials to the corresponding analytes, and thus, the application. The color change – from colorless (no toxic substance) to blue (toxic substance detected), for example – warns the employee immediately. "By synthesizing the adapted color sensor materials, we can detect gases like carbon monoxide, for example, or hydrogen sulfide. Still, this protective gear represents only one potential area of application. Sensor materials could also be deployed for the quick detection of leaks in gas lines," explains Dr. Sabine Trupp, head of the Fraunhofer EMFT Sensor Materials group. The researcher and her team will exhibit this occupational safety article of clothing at Fraunhofer's joint exhibition booth (Hall 12, Booth 537) at the Sensor + Test trade show in Nuremberg from May 14 to 16.

### Tailor-made indicator dyes

The warning signal is triggered by an indicator dye integrated into the glove that reacts to the presence of analytes, in this case, the toxic substances. The experts at EMFT used a variety of techniques in order to furnish textiles with sensor-activated dyes. The sensor-activated dyes are applied to the clothing with the customary dye and print process, for example, by affixing them in an immersion bath. Previously, the researchers used targeted chemical modification to adapt the color molecules to the fiber properties of the respective textile. Alternatively, the textiles can also be coated with sensor particles that are furnished with sensor dyes. For this purpose, the scientists integrated the dye molecules either into commercial pigments or they built them up on an entirely synthetic basis. The pigments are then manufactured according to the customary textile finishing process, for instance, the sensor particles are also suitable for silkscreening. "Which version we opt for depends on the requirements of the planned application," says Trupp.

The challenge lies foremost in the tailored development of sensor dyes. "The dye molecule must detect a specific analyte in a targeted manner – only then will a chemi-

cal reaction occur. Moreover, the dye must adhere securely; it cannot disappear due to washing. We aim for the customer's preferences in the color selection as well. All of these aspects must be kept in mind when developing the molecule and pigment properties," explains Trupp.

The expert already has new ideas about how the solution could be developed further. For example, a miniaturized sensor module, integrated into textiles, could record toxic substances, store the measurement data and even transmit them to a main unit. This way, you could document how frequently an individual within a hazardous environment was exposed to poisonous concentrations over a longer period of time.

The researchers also envision other potential applications in the foodstuffs industry: In the future, color indicator systems integrated into foils or bottle closures are intended to make the quality status of the packaged foods visible. Because the sell-by date does not represent a guarantee of any kind. Foodstuffs may often spoil prematurely - unnoticed by the consumer - due to a packaging error, or in the warehousing, or due to disruptions in the refrigeration chain. Oil-based and fat-containing products are specifically prone to this, as are meats, fish and ready meals.



The sensor glove turns blue in the presence of hazardous substances. (© Fraunhofer EMFT) | Picture in color and printing quality: [www.fraunhofer.de/press](http://www.fraunhofer.de/press)

## OLED brings out the shine

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The age of the good old cathode ray tube has long since passed. According to the German Federal Statistics Office, by 2011, almost every other German household had a flat screen television. The question, however, is how long our boob tubes – measuring just a few centimeters thick – will manage to hold onto the moniker “flat.” Rigo Herold of the Fraunhofer Research Institution for Organics, Materials and Electronic Devices COMEDD is already thinking in totally different dimensions in any case: “In 2008, the first manufacturers introduced displays that were less than a millimeter thick.” The technology behind these incredibly narrow matt screens is called OLED. The abbreviation stands for “Organic Light Emitting Diode.” “OLEDs emit light themselves, and unlike the ordinary liquid crystal display screens of today, they work without background lighting. For this reason, it will soon be possible to manufacture very thin and simultaneously very flexible, bendable displays,” explains Herold, who is in charge of “IC and Systems Design” at COMEDD. What you previously knew only from science fiction flicks could also change our everyday viewing experience within the foreseeable future: Screens as thin as paper, applied to clothing, curtains and even windows.

Yet the technology is still in its infancy stages. Beside the minimal lifespan, up to now the extremely high acquisition costs are impeding a widespread breakthrough. “Producing organic light diodes is still very expensive. This is why you still cannot purchase large-scale OLED television screens currently. Right now, the technology is being used primarily for very small screen sizes of just a few square centimeters. Examples include the ViewFinder on digital cameras or – even smaller – on cellphone beamers and data glasses,” as Herold describes the state of the art. Together with his colleagues, he is researching new production methods for microdisplays.

### Subpixels applied directly onto microdisplays

The researchers recently achieved an important breakthrough in this area: Together with VON ARDENNE Anlagentechnik GmbH they are developing a technology for producing mini-OLED screens without color filters. That makes the production process not only cheaper, but even improves the luminosity of the microdisplays. Until now, the color filter suppressed the self-radiance of the OLED, so that only about 20 percent of the emitted light could be used. Two negative effects from the filter sheet being used are responsible for this: First, it suppresses two of the three color ranges of an OLED subpixel; second, as an additional layer applied over the OLED, it automatically dims the generated light.

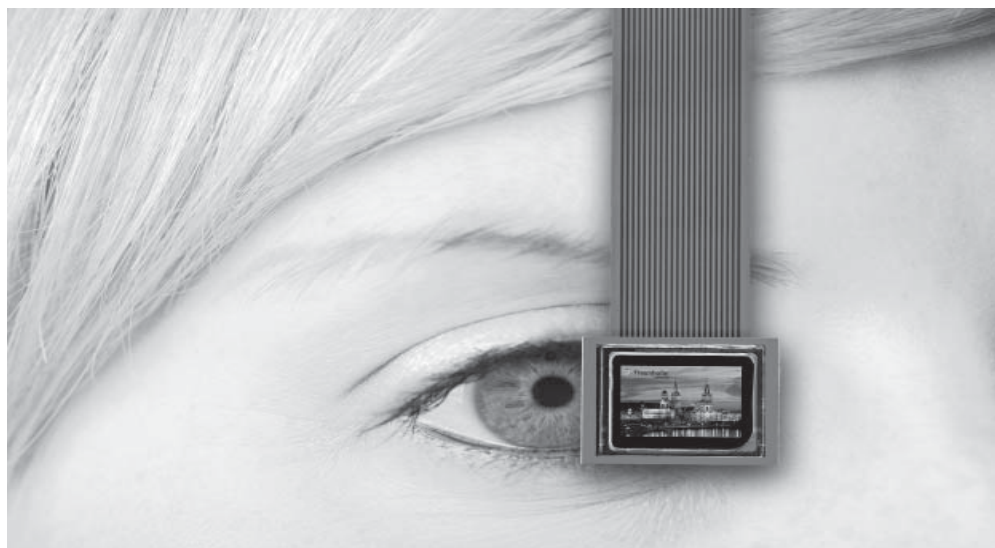
In order to circumvent the use of the color filter, the red, green and blue subpixels – which are integral to the depiction of a color image – must be loaded onto the OLED directly. That was previously impossible. “The subpixels in the tiny display are typically about 8 square micrometers in size. However, conventional technology only allowed for

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the processing of units greater than 50 square micrometers," says Herold, illustrating the challenge to be mastered. In order to resolve this set of problems, scientists employed a special technology made by VON ARDENNE, their partner company. This technology facilitates the targeted vaporization of organic layers locally, under heat. In this manner, surfaces can be processed that are smaller than 10 square micrometers. "In order to use the technology for OLED microdisplays, we redesigned the entire manufacturing process. It is therefore possible to load the red, green and blue color pixels directly. The use of the color filter is no longer necessary and it is possible to use 100 percent of the light emitted," says Herold.

### Smartphones hold up longer

Still, the OLED not only shine brighter, the new production process is also less expensive. Color filters are very expensive to produce. Depending on the application, they have to be custom-designed, consist of suitable materials and be mounted properly. If the filter shifts, for instance, that could have a negative impact on the image quality. "Ultimately, the consumer benefits as well: We all know that our mobile devices, like smartphones and digital cameras, consume a lot of energy each day. The less is used for the color presentation of the displays, the longer our batteries will last for telephone calls, surfing or taking pictures," Herold concludes.



**Microdisplays are barely larger than the human eye. A new, cost-effective process now lets them shine markedly brighter. (© Fraunhofer COMEDD) | Picture in color and printing quality: [www.fraunhofer.de/press](http://www.fraunhofer.de/press)**



## Using cattails for insulation

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Cattails have long been used for various purposes, like cleaning wastewater at sewage treatment plants, for detoxifying soils, as raw material for handcrafted wickerwork, as means of nutrition and, in traditional medicine, as a healing plant for various illnesses. Researchers at the Fraunhofer Institute for Building Physics IBP in Valley now want to use this gift of nature as a building material – to wit, for the insulation of outer walls or reinforcement of plaster. Dr. Martin Krus, Head of Test Center at IBP, testifies as to the numerous positive, construction-related properties of this renewable raw material: “As one of nature’s swamp plants, cattails are resistant to molds and are very well equipped to deal with moisture. The leaves of the plant have a fiber-reinforced supporting tissue that is filled up with a soft sponge tissue. Through this special construction, they are extraordinarily stable and possess an excellent insulating effect. This effect is also preserved in the finished products.” The researcher already has such a product. Working in close consultation with cooperation partner typha technik Naturbaustoffe, he developed a magnesite-bound insulation panel made of Typha (Latin for “cattail”) that already has a patent application pending. The panel features a low heat conductivity of 0.052 W/mK (watts per meter and Kelvin). It delivers excellent fireproofing, sound-proofing and heat insulation, and is relatively permeable, but sufficiently tight so that, with most applications, one can dispense with a vapor control barrier. Most of all, the material can cope with high pressure parallel to the panel surface. The researcher and his team were able to validate the excellent values of the Typha panel following one-and-a-half years of measurements conducted in a traditional half-timbered home in Nuremberg. Its outer walls, as well as the timber work, were retrofitted with Typha. “The local craftsmen were enthused by this sustainable material,” says Krus.

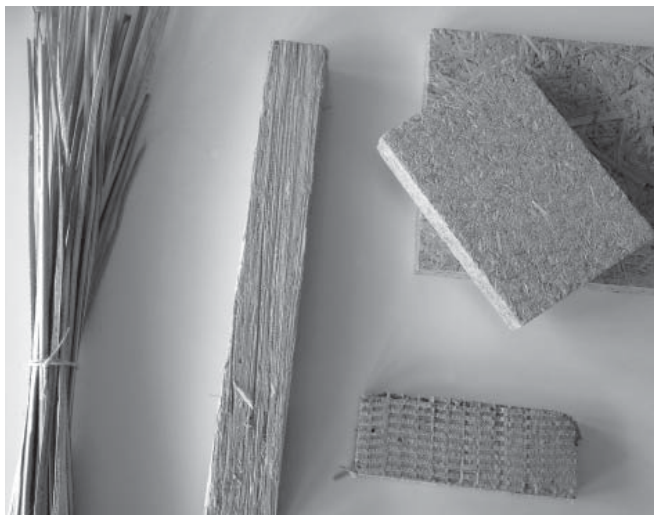
## Lowland moors regenerated by Typha cultivation

Despite the numerous advantages of Typha, so far this natural building material has yet to be installed on a wide scale, or industrially exploited. “Cattails are highly prolific, especially in East Europe – mainly Romania and Hungary. The wetland plant is not being cultivated in this part of the world, so it would have to be imported extra,” as the engineer relates an important obstacle. In this respect, he indicated that there would be suitable cultivation areas in Germany. For example, dried out lowland moors that were used for agricultural purposes for decades could be revitalized by cultivating Typha. Scientists have already shown that this is possible through the “Cattail Cultivation in Lowland Moors” project sponsored by the Deutschen Bundesstiftung Umwelt DBU (German Federal Environment Foundation) and headed by the Chair for Landscape Ecology at the Munich University of Technology. “Drained lowland moors are a source of CO<sub>2</sub> emissions. Each year, up to 40 million tons of carbon dioxide are released in Germany by draining,” Krus affirms. By comparison: Automobile traffic in Germany causes an annual release of 105 million tons of CO<sub>2</sub>. This process could be stopped, though, by cultivating cattails. The depletion is reduced and many nutrients remain in

the soil. At the same time, cattail surfaces offer habitats for rare plants and animals. "Therefore, typha cultivation also contributes to environmental protection," says the scientist.

There would be no impediment to high yields, since cattails are extremely fast-growing. Krus acknowledges that the harvested typha has excellent sales potential. "The plant can be processed easily," stressed the researcher. The leaves are detached horizontally into rod-like particles and then shortened at the correct length of around seven centimeters. Next, they are sprayed in a drum with environmentally-sound mineral adhesives and brought into a heated press. Currently, this process is performed manually. The expert and his colleagues have not yet found a manufacturer willing to undertake serial production of the panels. "Certainly the typha panel would be extraordinarily competitive if they were produced in a series production process," the scientist asserts enthusiastically.

Based on the numerous positive technical properties and the complete recyclability into the materials cycle, typha offers a truly diverse range of potential uses. Because of the high flexural rigidity and simultaneously low weight, the material can be used for roof construction or as a lightweight sandwich element for flooring and intermediate ceilings. It can also be used to design door leafs, window and door lintels; it is likewise possible to replace timber beams. The IBP researchers themselves realized plaster reinforcement with seed parachutes by mixing the seed parachutes of the cattail plants into the lime plaster, to prevent the formation of fissures. "In principle, one could build an entire building out of Typha, if one excludes pipes, windows and the roofing," says Krus.



**Cattail (Typha) in various stages of processing. The insulation panel is shown above right.**  
**(© Fraunhofer IBP) | Picture in color and printing quality: [www.fraunhofer.de/press](http://www.fraunhofer.de/press)**

## Perfectly designed microelectronics

The European Commission has defined micro- and nanoelectronics as one of five key technologies for Europe. At the moment, this segment of industry accounts for ten percent of Europe's gross domestic product (GDP). Miniaturized electronic circuits fulfill a broad range of important technical functions: they not only control our PCs, tablets, smartphones, and DVD players. Without them, the power grid would be far less efficient, airbags would not pop open, and medical devices would not be able to function. "The trend is going toward ever smaller and more complex components. Today, electronic circuits are smaller than a few square millimeters and already contain individual elements such as transistors, electronic resistors, capacitors, resonators, or micro-controllers," says Charles-Alix Manier of the System Integration and Interconnection Technologies department at the Fraunhofer Institute for Reliability and Microintegration IZM in Berlin.

### Stacking saves space

The researchers have developed a production process that makes it possible to miniaturize a certain type of microchip even further: programmable oscillators. These are responsible for temporal synchronization and the transmission of information in electronic devices. For instance, the tiny 1.5-square millimeter circuits are part of wireless communication systems such as GSM or Bluetooth, as well as of MP3 or DVD players and navigation systems. The microtechnology experts at IZM stack the individual parts that make up the microsystem on top of each other instead of packaging these as separate components and placing them next to one another. So the module contains in itself all of the required components. Or, in other words, it is now possible to produce several thousand components simultaneously.

"This integration saves us a great deal of space and reduces the cost of the entire production process. This leads to a significant improvement with regard to productivity and miniaturization," says Manier. Each microelectronic component is replicated on one wafer. Most of them are circular silicon discs that are about one millimeter thick. They resemble CDs or DVDs, but with a diameter of up to 30 cm, they are larger. It is now the discs themselves that are joined together under vacuum and not individual components, which results in a large number of fully "packaged" microchips being produced in one step. "To prevent components from getting too thick, we apply a thinning process during the packaging process. In so doing, we can currently achieve module heights of less than 500 micrometers," says Manier in describing IZM's expertise. With the new module design, the researchers aim to reduce the size of the oscillator, which is packaged in silicon. At the same time, they aim to expand its range of application. The idea behind this is to reduce the circuit's surface and power consumption through System-on-Chip (SoC) integration combined with component stacking.

IZM expertise is currently being applied in the “Go4Time ([www.go4time.eu](http://www.go4time.eu))” European research project. Here, microelectronics experts from Finland, Germany, the Netherlands, Italy, and Switzerland are cooperating to optimize the design of the tiny circuits. The seven partners from research and industry have their eye on special oscillators. The problem is that the module frequency - the pace at which it transmits information – can vary depending on the temperature of the surroundings and the design of the integrated resonator. If this happens, there can be interference, a mobile phone connection can be interrupted, or an MP3 player may start skipping.

### **Programming oscillators directly**

To prevent this from happening, “Go4Time” is working on designing the timing module to be freely programmable. As a result, the frequency could be controlled, and temperature changes offset. “Our aim is to produce oscillators that are extremely efficient and suitable for all sorts of applications. This is a complex task that combines process development, industrial engineering, circuit design, and microelectronic assembly,” says Manier. Initial results are expected to be published over the course of the year, and a prototype of the timing module will be on display at the Sensor + Test 2013 trade show from May 14 to May 16 in Nurnberg (Hall 12, Stand 537).



**The tiny timing module is a mere 1.5-square millimeters thick. If its frequency fluctuates for any reason, electronic devices could temporarily fail to function properly. (© Fraunhofer IZM) | Picture in color and printing quality: [www.fraunhofer.de/press](http://www.fraunhofer.de/press)**

## Credit card fraudsters quickly exposed

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A look at your account balance has just given you a shock: what's going on here? While you have spent the last few weeks in the office and definitely haven't travelled abroad, your account balance shows that you bought electronics in Turkey and ate out in France. In such situations, customers just have to call their banks to get their money back. But this often means that the banks lose the money.

How can credit cards be better protected? Exercising caution with your wallet and keeping the card in your hands when using it is no longer enough: a restaurant's card reading device can be infected with Trojans without the restaurant owner being aware of it. These Trojans then pass the customer's credit card information on to third parties. Customers are also at risk when they purchase something online. For this reason, banks have introduced if-then rules that stop purchases from other countries if a certain amount is exceeded. In such cases, the card reading device's display shows a note indicating that the bank has refused to make the payment. Until now, bank employees have examined fraud cases manually and applied rules accordingly. But in recent years, cases of credit card fraud have exploded in number, and this approach has quickly reached its limits.

### Rapid texting

The "MINTify rule" software now supports bank employees and helps them apply appropriate rules. The software was developed by researchers at the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS in Sankt Augustin, in cooperation with their partners at PAYMINT. "Our software analyzes recent transactions that are stored in the credit card company's database. Depending on the size of the company, there can be as many as one million data sets per month," says Dr. Stefan Rüping, group manager at IAIS. "For these transactions, the software searches all possible rules and selects the ten to one hundred best options. The best thing about this program is that it finds the most suitable rules in 30 minutes to an hour." Over time, the researchers aim to make the system even faster, with the procedure lasting just a few minutes. Once this goal has been achieved, the software will also be attractive for companies trading in equity markets.

The banks must define a ratio between the levels of security they want for specific types of cards and consequently how many customers may then not be able to use their cards. The more fraudsters are stopped, the more real customers will face the problem of not being able to make a payment. In an ideal scenario, all fraudsters would be stopped and all customers would be served, but this is not feasible. A more realistic ratio would be "four fraudsters to one customer." Based on this aim, "MINTify rule" can initiate its analysis and select the best possible rules. "At some point it becomes clear whether or not a transaction was legal. The software can learn from this





## Set in the right light

RESEARCH NEWS

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There's a lot of truth to the expression "in the right light", because lighting is often the decisive element in setting the stage to best effect. Whether it involves unveiling a new car at a trade show or presenting a celebrity on a television show, the lighting has to be just right. While trade show halls and television studios are well equipped, things can be more challenging in outdoor situations. This is where the Mobilight mobile module comes in. Developed by the employees of APE LABS Lichtprodukte GmbH in Würzburg, the system's individual lighting modules are battery-operated and wireless. To create the appropriate atmosphere, the individual LED devices coordinate lighting brightness and color selection over the air, at 2.4 Ghz.

But APE LABS was not entirely satisfied with the first generation of Mobilight. The mix of colors did not entirely achieve the desired effect, as the color was not evenly distributed over the illuminated surfaces. APE LABS employees also saw room for improvement when it came to spotlight size. Moreover, the lens towered about 20 centimeters above the device and was held by long screws. "Our aim was to make the Mobilight smaller and more compact, the illuminated surface larger and the light more even. In addition, we wanted to create a single module that could generate three rays of light rather than just one," says Julius Schrenk, the founder of APE LABS.

### Compact optical components

The small company, which counted 11 employees at the time, looked for support among its neighbors, namely at the Fraunhofer Institute for Silicate Research ISC. "First, we optimized the quality of the light beams, as well as their width and the quality of the color mix for individual colors with a special software", says Jens Baber, who headed the project at ISC in Würzburg. "It appeared that commercially available lenses would work well together with the software. But this solution would have been too expensive." So the researchers tried to come up with an alternative, and this proved to be a real challenge since the module offered only eight to ten centimeters of space. This meant that the optical components had to be very small. What is more, the LEDs that form the basis of the Mobilight module shine their light in every direction. And the red, green, blue, and white colors come from different sources of light. While the researchers do not wish to reveal exactly how they managed to focus the rays of light, they did say this much: they borrowed ideas from laser technology.

Their approach was successful. The new generation Mobilight 3 not only meets technical requirements. With a footprint of 21 by 21 centimeters and a height of 13 centimeters, it is more compact than its predecessor and achieves a significantly higher level of brightness. APE LABS will be unveiling the Mobilight 3 and demonstrating different lighting effects on May 8, 2013, at the opening of ISC's new extension building. This

will mark the successful conclusion of the company's first cooperation with Fraunhofer researchers, and the next project with APE LABS has already been initiated.



Impressive lighting effects can be achieved with the Mobilight 3, the portable wireless lighting system. (© APE LABS Lichtprodukte GmbH) | Picture in color and printing quality: [www.fraunhofer.de/press](http://www.fraunhofer.de/press)



## An energy-efficient electrical system for vehicles

Today's cars are computers on wheels: they comprise up to 80 embedded computing systems and many gigabytes of software that control all types of components and extra technical features, everything from braking assistance systems over CD players to navigation systems. And control units will be responsible for a growing number of functions, which means that the number of embedded systems in vehicles will continue to increase. This development has one main disadvantage: on-board computer systems consume a significant amount of energy, and therefore have a negative impact on fuel consumption. To increase the energy efficiency of control units, the units themselves can be designed in a more efficient manner. At the same time, the vehicle's electrical system, which enables the interplay of devices can be designed with greater efficiency in mind.

The Fraunhofer Institute for Communication Systems ESK in Munich offers a broad range of solutions for energy efficiency. Over the course of the "Dynasoft" project, ESK researchers have developed adaptive methods which allow embedded computers to carry out functions only when the driver actually needs them. For instance, the parking assistant remains turned off on the highway, while cruise control is switched off when drivers are parking their cars. Scientists working on the "SEIS" project, which stands for "Security in Embedded IP-based Systems", have taken a different approach. Thanks to new ways of controlling the operations of sub-networks, control units that aren't needed can be switched off, and this reduces energy consumption.

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## Commercial traffic can open the door to electromobility

Despite numerous initiatives, electromobility has yet to achieve a major breakthrough in the area of passenger vehicles. Has the industry been focusing on the wrong market? "When compared with private passenger cars, e-mobility is already very attractive for commercial vehicles," says Professor Martin Wietschel of the Fraunhofer Institute for Systems and Innovation Research ISI in Karlsruhe. Over the past year, researchers at the institute have examined and analyzed 350 commercial driving profiles across Germany. "For up to one million small delivery trucks and cars, it would make sense for operators to switch from the internal combustion engine to electric drives in the future." This would be a fourth of all commercial vehicles in Germany. E-vehicles make sense in any situation where the vehicles are in use on a daily basis, and where plannable routes of a limited distance are the norm. This is the case, for instance, with package delivery or outpatient care services.

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Together with the partners of the "Regional Eco Mobility 2030 ([www.rem2030.de](http://www.rem2030.de))" innovation cluster, Wietschel has already created a comprehensive database. "Until now, there have hardly been any data on the driving patterns of commercial vehicles in cities. Private passenger vehicles have been the main focus," says the head of the Energy Management department at ISI. The cluster has a broad interdisciplinary set-up that includes not only research institutes, OEMs, municipalities, and associations. "The market analysis also provides us with data that will enable us to develop a modern city vehicle, one that will combine battery and fuel cell technology and integrate intelligent software solutions," says Wietschel in explaining the goals of REM 2030.

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## Digital signature: stored for eternity

While ink signatures on paper may not last forever, they do keep for several decades. The situation is different for digital signatures. Since they are based on a series of the digits 0 and 1, they remain legible for a long period of time. However, even today's best signature algorithms cannot provide long-term protection from forgery. Once the applied signature algorithm no longer meets current security standards, fake signatures cannot be distinguished from the original, and the signature becomes worthless. For this reason, digital signatures must be adapted to security standards in time. To this end, ArchiSoft software can provide effective support. It was developed by researchers at the Fraunhofer Institute for Secure Information Technology SIT in Darmstadt and brought to market by AuthentiDate and intarsys.

Germany's Federal Network Agency establishes which algorithms are deemed secure in its annual algorithm catalog. According to this catalog, two very widespread algorithms will lose their security rating at the end of 2015. Until now, every digital document whose signature is no longer adequate has had to be certified with an external agency's timestamp. Since each timestamp costs several cents, the costs of having inadequate signatures can skyrocket when millions of documents need to be certified. ArchiSoft helps solve this problem by grouping documents in such a manner that all documents can be certified with a single timestamp. Rather than costing thousands of euros, doing this costs only a few cents.

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