Fraunhofer Gesellschaft

Research News

No. 12 – 2008

Fraunhofer Press
Phone: +49 89 1205-1302
presse@zv.fraunhofer.de
www.fraunhofer.de/press

1 Avalanches – triggered from the valley

When slab avalanches thunder into the valley, winter sports fans are in danger. Researchers have now gained amazing insights into the formation of these avalanches – especially regarding how they are remotely triggered by skiers in more gently inclined areas.

2 Toys made of liquid wood

Most plastics are based on petroleum. A bio-plastic that consists of one hundred percent renewable raw materials helps to conserve this resource. Researchers have now optimized the plastic in such a way that it is even suitable for products such as Nativity figurines.

3 Particulate emissions from laser printers

Do laser printers emit pathogenic toner particles into the air? Some people are convinced that they do. As a result, this topic is the subject of public controversy. Researchers have now investigated what particles the printers really do release into the air.

4 Production line for artificial skin

A fully automated process is set to improve the production of artificial tissue: medical scientists can perform transplants with skin produced in the laboratory. This tissue is also suitable for testing chemicals at a low cost without requiring animal experiments.

5 Keeping track

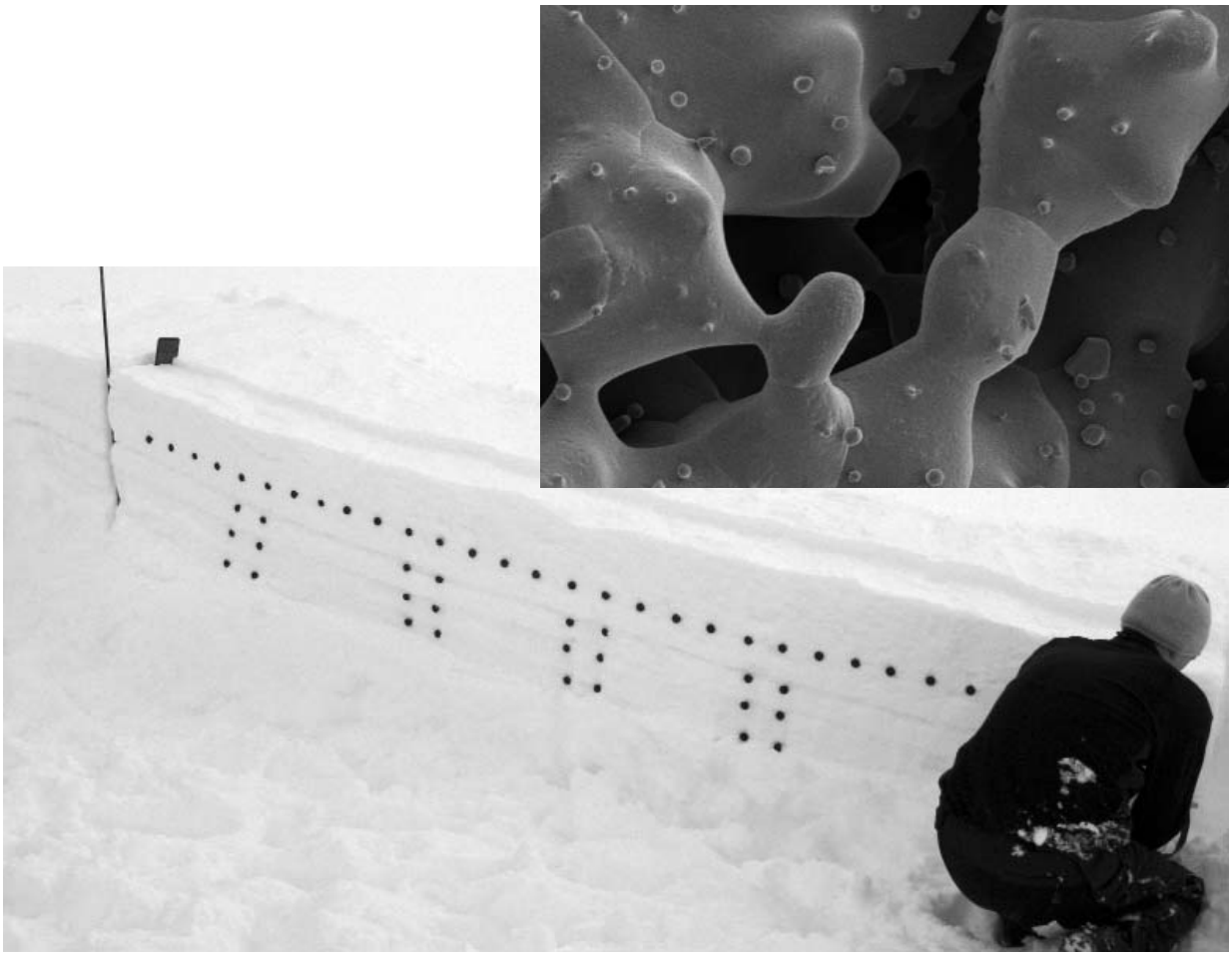
Aircrafts and fueling vehicles move around, cleaning brigades come and go. Security staff keep watch on everything to ensure nobody gets into danger. A software will soon help them with their task: It locates people and objects, and immediately detects unauthorized persons.

6 Rust-proof – even without chromium

For a long time, chromium plating protected car bodies against rust – but this has been prohibited since 2007. However, chromium-free coatings are not suitable for universal use; they have to be adapted to the respective application. A new chromium-free coating can help.

7 Plastic as a conductor

Plastic that conducts electricity and metal that weighs no more than a feather? It sounds like an upside-down world. Yet researchers have succeeded in making plastics conductive and cutting production costs at the same time.



© © A. van Herwijnen, Institut für Schnee- und Lawinenforschung, Davos (bottom), Jane Blackford und Chris Jeffree, Universitaet Edinburgh (top)

The interstices between the ice crystals play a significant role in the formation of cracks in the snow (above). Field test to demonstrate the anti-crack model (below).

Picture in color and printing quality: www.fraunhofer.de/press

FraunhoferInstitute for Mechanics of Materials IWM
Wöhlerstraße 11
79108 Freiburg, Germany
Press contact:
Thomas Götz
Phone +49 761 5142-153
Fax +49 761 5142-110
thomas.goetz@iwm.fraunhofer.de
www.iwm.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 1

No. 12 – 2008

Avalanches – triggered from the valley

Everybody knows that skiers swishing down steep slopes can cause extensive layers of snow to slide down. But there is a less well known phenomenon: A person skiing on gentler slopes in the valley triggers a slab avalanche on the slope, sometimes several hundred meters further uphill. This scenario doesn't seem to make sense – yet it claims human lives year after year.

But what exactly happens when an avalanche is remotely triggered? "In a slab avalanche, the upper layer of snow slides down into the valley. For that to be able to happen, it first has to become detached from the layer beneath it," says Prof. Dr. Peter Gumbsch, director of the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg. The view commonly held until now assumes that the layers of snow are separated by shear cracks – the upper layer shifts within a limited area. If the two layers of snow were two hands placed palm to palm, a shear crack would be equivalent to rubbing one hand against the other. The layers of snow can only shift if the slope is steep enough. Shear cracks are a satisfactory explanation for the breakaway of snow slabs in steep terrain. But how can they be triggered from a distance?

Gumbsch and his colleagues Michael Zaiser and Joachim Heierli at the University of Edinburgh, Scotland, have developed a physical model that explains this phenomenon. "The boundary layer that connects the layers of snow is made of ice crystals with fairly large interstices," explains Heierli. The pressure exerted by a skier can cause the ice crystals to break, separate from one another and slip into the interstices – the layer collapses. The layer on top of it also subsides. This mass collapse, which could be described as an anti-crack, releases energy that has never previously been taken into account. This energy enables the crack to propagate. To return to our previous analogy, the anti-crack would be like pressing the two hands together. Experiments carried out by Canadian researchers at the University of Calgary confirm the theory: Whether the slope is gentle or steep, it is equally difficult to trigger a break. Once it has started, it propagates as an anti-crack. It can move up or down the mountain and grow to a length of several hundred meters within a few seconds: The layers of snow lose their cohesion. Only the forces of friction can then prevent the snow from slipping. If these are not adequate, the upper layer slides off and a slab avalanche is created.

For further information:
Prof. Dr. Peter Gumbsch
Phone +49 761 5142-100
Fax +49 761 5142-400
peter.gumbsch@iwm.fraunhofer.de

Joachim Heierli
Phone +44 131 650 5693
j.heierli@ed.ac.uk

Nativity figurines made of liquid wood.

Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Chemical Technology ICT
Joseph-von-Fraunhofer-Straße 7
76327 Pfinztal / Berghausen
Germany
Press contact:
Dr. Stefan Tröster
Phone +49 721 4640-277
Fax +49 721 4640-730
stefan.troester@ict.fraunhofer.de
www.ict.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 2

No. 12 – 2008

Toys made of liquid wood

Toys have to put up with a lot of rough treatment: They are sucked by small children, bitten with milk teeth, dragged along behind bobby cars, and every now and then they have to survive a rainy night outdoors. Whatever happens, it is vital that the material does not release any softeners or heavy metals that could endanger children.

Toys can be made of liquid wood in future. The advantage is that this bio-plastic, known as ARBOFORM®, is made of one hundred percent renewable raw materials and is therefore not reliant on petroleum. Researchers at the Fraunhofer Institute for Chemical Technology ICT in Pfinztal and the Fraunhofer spin-off TECNARO GmbH have developed the material. But what exactly is liquid wood? "The cellulose industry separates wood into its three main components – lignin, cellulose and hemicellulose," explains ICT team leader Emilia Regina Inone-Kauffmann. "The lignin is not needed in papermaking, however. Our colleagues at TECNARO mix lignin with fine natural fibers made of wood, hemp or flax and natural additives such as wax. From this, they produce plastic granulate that can be melted and injection-molded." Car parts and urns made of this bio-plastic already exist, but it is not suitable for toys in this form: To separate the lignin from the cell fibers, the workers in the cellulose industry add sulfurous substances. However, children's toys should not contain sulfur because, for one reason, it can smell very unpleasant.

"We were able to reduce the sulfur content in ARBOFORM by about 90 percent, and produced Nativity figurines in cooperation with Schleich GmbH. Other products are now at the planning stage," says TECNARO's managing director Helmut Nägele. This is a challenging task: Sulfur-free lignins are usually soluble in water – and therefore unsuitable for toys. On no account must they dissolve if they are left out in the rain or if children suck them. With the aid of suitable additives, the TECNARO scientists were able to modify the bio-plastic in such a way that it survives contact with water and saliva undamaged. Can the material be recycled? "To find that out, we produced components, broke them up into small pieces, and re-processed the broken pieces – ten times in all. We did not detect any change in the material properties of the low-sulfur bio-plastic, so that means it can be recycled," says Inone-Kauffmann.

For further information:
Emilia Regina Inone-Kauffmann
Phone +49 721 4640-427
Fax +49 721 4640-111
emilia.regina.inone@
ict.fraunhofer.de

Helmut Nägele
Phone +49 7062 9178902
Fax +49 7062 9178908
helmut.naegele@tecnaro.de

© Fraunhofer WKI

In a test chamber, researchers investigate what kind of particles laser printers release into the ambient air.

Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Wilhelm-Klauditz-Institut WKI
Bienroder Weg 54 E
38108 Braunschweig, Germany
Press contact:
Simone Peist
Phone +49 531 2155-208
Fax +49 531 2155-200
info@wki.fraunhofer.de
www.wki.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 3

No. 12 – 2008

Particulate emissions from laser printers

We regularly hear reports that laser printers release pathogenic toner dust into the ambient air. How much of it can we believe? What kind of particles do the printers really emit, and in what quantities? Researchers at the Fraunhofer Wilhelm Klauditz Institute WKI in Braunschweig are investigating this question in collaboration with colleagues from Queensland University of Technology QUT in Brisbane, Australia. The results are surprising: Contrary to numerous reports, laser printers release hardly any particles of toner into the air. "But what some printers do emit are ultra-fine particles made of volatile organic-chemical substances," says WKI head of department Prof. Dr. Tunga Salthammer. "One essential property of these ultra-fine particles is their volatility, which indicates that we are not looking at toner dust."

So where do these ultra-fine particles come from? And how can their emergence be explained? To discover the answer, the scientists have developed a process that enables them to determine and compare the quantity, size and chemical composition of the emitted particles. Technical and financial support was provided by the printer and copier manufacturers in the German Association for Information Technology, Telecommunications and New Media (BITKOM). Depending on their dimensions, the printers are housed in a test chamber measuring one or 24 cubic meters. Particle analyzers count the particles and measure their size distribution. To discover the source, the researchers also examined modified printers that "print" without any paper or toner. "The amazing thing is that the ultra-fine particles are still produced even in this case. The culprit is the fixing unit – a component that heats up as high as 220°C during the printing process in order to fix the toner particles on the paper," explains WKI scientist Dr. Michael Wensing. The high temperatures cause volatile substances such as paraffins and silicon oils to evaporate, and these accumulate as nanoparticles. The scientists from Braunschweig observed similar phenomena – the formation of ultra-fine particles of volatile organic substances when heated – during typical household activities such as cooking, baking, or making toast. Filters are available on the market to reduce these printer emissions. But are they any use? "Our investigations show that the various external filters on offer for printers operate in very different ways. As the ultra-fine particles are not emitted from a specific part of the printer, but also from the paper output, for instance, a filter can only have a limited effect."

For further information:
Prof. Dr. Tunga Salthammer
Phone +49 531 2155-350
Fax +49 531 2155-905
tunga.salthammer@
wki.fraunhofer.de

Dr. Michael Wensing
Phone +49 531 2155-331
Fax +49 531 2155-905
michael.wensing@wki.fraunhofer.de

Researchers culturing artificial skin.

Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB
Nobelstraße 12
70569 Stuttgart, Germany
Press contact:
Dr. Claudia Vorbeck
Phone +49 711 970-4031
Fax +49 711 970-4200
claudia.vorbeck@
igb.fraunhofer.de
www.igb.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 4

No. 12 – 2008

Production line for artificial skin

Some patients wish they had a second skin – for instance because their own skin has been burnt in a severe accident. But transplanting skin is a painstaking task, and a transplant that has to cover large areas often requires several operations. Medical scientists have therefore been trying for a long time to grow artificial tissue. This "artificial skin" would allow them to treat these patients better and faster.

Tissue engineering has been at the focus of research for many years, and tissues such as cartilage or skin are already being cultured in numerous biotechnology laboratories. But the researchers at the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart plan to go a step further than that. They are aiming to enable fully automated tissue production. "Until now, methods of culturing tissue like that used for skin transplants have been very expensive," says IGB head of department Professor Heike Mertsching. "Most of the steps are carried out manually, which means that the process is not particularly efficient." The researchers have therefore elaborated a novel conceptual design in collaboration with colleagues from the Fraunhofer Institutes for Production Technology IPT, Manufacturing Engineering and Automation IPA, and Cell Therapy and Immunology IZI.

First of all, a biopsy – that is, a sample of human tissue – is checked for sterility. A gripper arm then transports the biopsy into the automated device where the individual steps are performed: The machine cuts the biopsy into small pieces, isolates the different cell types, stimulates their growth, and mixes the skin cells with collagen. A three-dimensional reconstruction of the different skin layers is produced with the aid of a special gel matrix – and the skin is ready. In the final step, the machine packages the cells for shipment. Alternatively, the tissue can be cryopreserved – that is, deep-frozen and stored for later use. "It was important for us that the entire mechanical process is divided into separate modules," says Mertsching. "This enables us to replace or modify individual modules, depending what is needed for the production of different tissue types." The method opens up almost unlimited new possibilities for the medical scientists. One of their upcoming projects is to produce intestinal tissue for resorption tests.

For further information:
Prof. Dr. Heike Mertsching
Phone +49 711 970-4117
Fax +49 711 970-4047
heike.mertsching@igb.fraunhofer.de

© Fraunhofer IIS

It is difficult for security officers to keep everything in view on the apron. Who is entitled to be there? Who is not authorized? Where is there a risk of accident?

Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Integrated Circuits IIS
Am Wolfsmantel 33
91058 Erlangen, Germany
Press contact:
Marc Briele
Phone +49 9131 776-1630
Fax +49 9131 776-1649
presse@iis.fraunhofer.de
www.iis.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 5

No. 12 – 2008

Keeping track

The apron of an airport is a hive of activity. Ground staff drive baggage trolleys to the aircraft, load air freight containers in the hold and refuel the aircraft. Cleaning brigades have to clean the aircraft before new passengers can board it. But which persons, vehicles and objects are moving around on the apron? Are all the people authorized to be there? Are people getting into hazardous situations? For the security staff who have to supervise the terrain on the monitor, it is almost impossible to keep track of everything.

A new technology sponsored by the EU will greatly facilitate the work of the security staff in future: LocON is a platform developed by researchers at the Fraunhofer Institute for Integrated Circuits IIS in collaboration with European partners. It enables automatic gate-free access control, both for the people who work there and for vehicles and other objects. LocON permanently locates all persons and objects by radio. "The security staff watches the entire airfield on a huge monitor," explains René Dünkler, head of marketing at the IIS. "LocON recognizes everything that moves on the airfield and is authorized to do so – in real time." To make this possible, all employees wear an electronic identity badge that transmits a radio signal and thus the person's location and identification to the LocON platform. Vehicles, air freight containers and other objects are also equipped with a tag that emits radio signals. "LocON can process various types of radio positioning signals, GPS and RFID alike," says Dünkler. Combining it with video surveillance systems offers even greater potential: Until now, security officers always had to keep an eye on several monitors showing the images from various cameras, and to know which people were authorized to be there. In future, robocams could track two persons and automatically compare their motion profiles with the positioning data from LocON. If the system discovers anything wrong – if there is any risk of an accident –, the security officers receive an alert.

LocON's pilot application is already lined up: The researchers are to install it at Portuguese airports in a joint effort with leading location system providers. In future, LocON will increase security in other areas too: for instance on building sites, at train stations or on company premises, as well as in harbors, hospitals and shopping centers. The engineers are also working on standardization measures to improve security at high-risk facilities.

For further information:
René Dünkler
Phone +49 9131 776-3103
Fax +49 09131 776–3199
rene.duenkler@iis.fraunhofer.de

Fraunhofer Institute for Silicate Research ISC
Neunerplatz 2
97082 Würzburg, Germany
Press contact:
Marie-Luise Righi
Phone +49 931 4100-128
Fax +49 931 4100-399
righi@isc.fraunhofer.de
www.isc.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 6

No. 12 – 2008

Rust-proof – even without chromium

Years ago, the ice-cream van used to drive through residential areas, ringing a bell to entice people out of their houses. Today their place has been taken by scrap metal collectors. Whether it be refrigerators, washing machines or car parts – the dwindling natural resources mean that scrap metal is worth money. To ensure that the recycling of old cars, for example, does not pose a risk to human health and the environment, the European Parliament has issued a guideline: The use of toxic and carcinogenic chromium(VI) compounds in car manufacturing has been prohibited since mid-2007. Until then, a chromate layer underneath the paint protected the car body against corrosion. Since that time, several chromium(VI)-free protective coatings have made their way into industrial halls – but they do not afford the same degree of protection as chromium(VI) plating, and cannot be used on all types of metal surface.

Researchers at the Fraunhofer Institutes for Silicate Research ISC in Würzburg and for Machine Tools and Forming Technology IWU in Chemnitz, along with colleagues at the Institute for Corrosion Protection Dresden GmbH, have developed an alternative – based on nanocomposites. "The new nanomaterials we developed using the sol-gel method adhere very well to most types of galvanization that we examined," reports ISC project manager Dr. Johanna Kron. To produce them, the researchers dipped galvanized steel sheets into a coating sol and applied a powder coating. They subjected the coated sheets to a variety of load tests. One such test was to keep scratched steel sheets in a chamber filled with atomized brine for 360 hours, or 15 days, at a temperature of 35 degrees. They also placed the metal sheets in an environment chamber with a relative humidity of 100 percent for 240 hours, or 10 days. "These coatings protect most galvanized materials almost as well as commercial yellow chrome plating. Indeed, the new coatings are often even more effective than the chromium-free system and chromium(III) passivation currently on the market," says Kron.

Good anti-corrosion measures are one thing, but is it also possible to deep-draw and bend the metal sheets treated in this way without destroying the coating? "As the coatings are less than a thousandth of a millimeter thick, you can form the chromium-free coated metal sheets in exactly the same way as yellow chrome plated sheets," says Kron. The researchers can already produce the corrosion proofing on a laboratory scale. Kron believes that the system could be launched on the market in about five years' time.

For further information:
Dr. Johanna Kron
Phone +49 931 4100-631
Fax +49 931 4100-698
johanna.kron@isc.fraunhofer.de

Dipl.-Ing. Patricia Weigel
Phone +49 371 5397-1114
Fax +49 371 5397-61114
patricia.weigel@iwu.fraunhofer.de

© Fraunhofer IFAM

A plastic-metal hybrid as a granulate or a strand. In the next step the conductive material can be plasticized (softened) again and applied as a printed circuit board.

Picture in color and printing quality: www.fraunhofer.de/press

Fraunhofer Institute for Manufacturing Technology and Applied Materials Research IFAM
Wiener Strasse 12
28359 Bremen, Germany
Press contact:
Anne-Grete Becker
Phone +49 421 2246-568
Fax +49 421 2246-430
anne-grete.becker@
ifam.fraunhofer.de
www.ifam.fraunhofer.de

Fraunhofer Gesellschaft

Research News
Topic 7

No. 12 – 2008

Plastic as a conductor

You could hardly find greater contrasts in one and the same team. Plastic is light and inexpensive, but insulates electric current. Metal is resilient and conducts electricity, but it is also expensive and heavy. Up to now, it has not been possible to combine the properties of these two materials. The IFAM in Bremen has devised a solution that combines the best of both worlds without requiring new machinery to process the components. The greatest challenge for the researchers was getting the plastic to conduct electricity, for plastic-metal hybrids are to be used in the very places where plastic components are equipped with printed circuit boards, for instance in cars or aircraft. Until now, this was only possible via the roundabout route of punching and bending metal sheets in an elaborate process in order to integrate them in a component.

The new solution is simpler: a composite material. The different materials are not merely slotted together or bonded, but mixed in a special process to form a single material. This process produces a homogeneous and fine-meshed electrically conductive network. The composite possesses the desired chemical stability and low weight, coupled with the electrical and thermal conductivity of metals. As it will no longer be necessary in future to integrate metal circuit boards and the components will soon be able to be produced in a single work step, the production costs and the weight of the material are drastically reduced.

Automobile and aircraft manufacturers, in particular, will benefit from this development. The headlamp housings on a car, for example, are made of plastic. Until now, punched metal sheets have been installed in order to illuminate the headlamps. If the housings were fitted with circuit boards made of the conductive plastic-metal hybrids, they could be produced more efficiently and at lower cost than ever before. Many components of an aircraft, such as the fuselage, are partly made of carbon fiber composites (CFC). However, they lack the ability to conduct electricity. A stroke of lightning would have fatal consequences. A plastic-metal hybrid would be a good alternative for discharge structures on components.

For further information:
Arne Haberkorn
Phone +49 421 2246-270
arne.haberkorn@ifam.fraunhofer.de