MINATEC® NEWSLETTER

Keep your eyes peeled: This issue contains an April Fools prank article!

MINA-NEWS

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Top news

Pixcurve image sensor: microelectronics free from planar sensors

In February Leti presented a functional prototype of an 11 mm x 7 mm CMOS image sensor whose unique feature is that it is curved. The innovation could lead to a spectacular reduction in the size and complexity of lenses. It also opens the door to a whole new breed of microelectronics where the flat format will no longer be the norm.

The Pixcurve sensor was made from a commercially-available image sensor that was thinned from 725 microns to less than 100 microns. The thinned sensor is flexible enough to be curved, with a curve radius of 65 millimeters. The curved sensor fits perfectly into a conventional package for planar sensors.

Standard processes combined with unique know-how

The curved sensor is fabricated using standard CMOS dicing, thinning, and packaging processes. However, orchestrating the processes required substantial R&D that led to seven patents.

So, why make a curved sensor? Mainly because camera lenses are also curved. A curved sensor combined with curved lenses minimizes the need for optical correction. At the Photonics West trade show held in the US earlier this year, Leti demonstrated that the same image quality could be obtained with a 24-mm lens for a curved sensor as with a 60-mm lens for a planar sensor.

For 30 years, the level of precision and complexity of fabrication processes has meant that flat sensors were the only option. Pixcurve has changed all that with an innovation that will challenge the "flat" world of microelectronics and better meet the needs of the equipment that uses the sensors.

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Innovation

Exploring the surface of $CuInS_2$ nanocrystals

What is the surface of copper-indium-sulfur nanocrystals really like? This is something that researchers, intrigued by the nanocrystals' high luminescence, have wanted to know for years. A team at INAC combined MRI and synchrotron images to shed light on the mystery.

The researchers discovered a very dense layer of native organic ligands that are constantly regenerated via a dynamic desorption-adsorption process. Therefore, it would be difficult for any new chemical agent to adhere to this surface in order to functionalize the nanocrystals. And functionalization—such as to make the nanocrystals compatible with an aqueous biological environment—is the ultimate goal. However, the research did indicate two potential strategies. One would be to slow down the ligand-exchange process, and the other would be to add protonating agents.

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Could UVB rays cause our DNA to oxidize?

Until now, it was considered that the damaging effects of UVB rays on DNA were due to the excitation of the bases, which produces pyramidine dimers. However, an experiment completed under French National Research Agency project OPHID, in which INAC is participating, showed that irradiation of genomic DNA at 295 nm also caused oxidation damage, particularly to the telomeres (DNA sequences located at the ends of the chromosomes).

The findings have raised numerous questions. How are DNA molecules ionized—and not merely excited—by such low energy? Does the phenomenon observed *in vitro* also occur *in vivo*? What are the effects on cells and health? We will have to wait a little longer for the answers: Researchers will begin by trying to understand the tipping point between excitation and ionization.

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Chips individually encrypted during fabrication

Leti and Mapper, an equipment manufacturer based in the Netherlands, recently announced a major innovation: an individual security code etched onto the metal interconnects of individual chips during fabrication. Mapper developed a multiple electron beam maskless lithography test machine, which Leti integrated into a standard 40 nm CMOS fabrication process. The machine can be adapted to other technologies, on 200 mm or 300 mm wafers.

Each individual chip's code can be accessed, but not modified. This type of chip could bring benefits to cybersecurity, traceability, and counterfeit prevention. Mapper is in talks with several manufacturers interested in testing the encryption technology on their wafers.

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Innovation

Lensless microscopy detects meningitis

In research conducted at La Timone University Medical Center in Marseille, scientists from Leti completed proof-of-concept testing on technique that uses a lensless microscope to diagnose meningitis. The technique, tested on more than 300 samples, was demonstrated to be just as reliable as and much faster than the current technique, which entails visual counting on an ordinary lab microscope.

Any suspected case of meningitis is a medical emergency. The illness killed 53 people in France in 2015. To be diagnosed, patients must undergo a spinal tap to collect cerebrospinal fluid. Leti's technique, which is protected by 25 patents, delivers an automated, non-operator-dependent analysis of the samples collected from patients. Now that the proof-of-concept testing has been completed, the researchers will make improvements to the analysis method and the red- and white-cell counting algorithm.

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TMD monolayers offer unrivalled superconductivity

Transition metal dichalcogenide (TMD) monolayers are promising candidates for future generations of transistors and for superconducting spintronics. The materials offer the advantage of retaining their superconducting properties even in the presence of very strong magnetic fields. Researchers at INAC dug deeper to come up with a theory to explain the phenomenon. They discovered that TMD monolayers, formed with heavy elements, present a very high intrinsic spin-orbit coupling.

However, doping the material as well as defects in the material's crystal lattice can reduce the impact of the coupling and, thus, the material's unrivalled capacity to withstand strong magnetic fields. In the worst-case scenario, the materials can even behave as ordinary superconductors. These theoretical findings will help researchers better assess the material's potential future uses.

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Giant magnetoresistance present in new structures

Researchers at Spintec have leveraged the latest advances in lithography to create new "lateral" structures in which giant magnetoresistance (GMR) has been observed. Rather than stacking ultra-thin magnetic and non-magnetic layers, the researchers deposited the layers on the same surface. For example, two magnetic materials can be separated by a non-magnetic spacer a few dozen nanometers thick.

The GMR variations measured on a pairing of cobalt and iron were in excess of 10%—the same as with conventional structures. Depending on how the layers are arranged on the surface, the magnetization can be oriented along three axes rather than just up or down. Research on these lateral structures is ongoing. Ultimately, they could be used in MRAM-type memory.

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Quantum computing: progress toward silicon-28

Since 2014, several scientific articles have presented the silicon-28 isotope as a good material for spin qubits for quantum computing. However, researchers had yet to produce the material in a CMOS environment, which uses natural silicon containing 4.7% isotope 29—not as suitable for qubits.

INAC and Leti recently made a first step forward with the assistance of a Russian laboratory* and Air Liquide. Using CVD to deposit isotope-28-enriched silane on a standard 300 mm wafer, the researchers obtained a 30 nm to 60 nm layer of 99.992% pure silicon-28.

The surface is smooth enough to withstand subsequent fabrication processes. The researchers used this new material to develop a volume-manufacturing process for the fabrication of spin qubits. The research was conducted under the EU MOS-Quito project**.

Institute of Chemistry of High Purity Substances
***MOS-based quantum information technology*

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Winter Olympics: innovation medal for Grenoble's 5G technology

Leti, which is coordinating the Europe-Korea 5GChampion consortium, gave a stellar performance at the Winter Olympics. In a world first, Leti and its partners successfully completed intercontinental proof-of-concept testing of the 5G network. The network, made up of terrestrial base stations, millimeter-wave multi-beam antennas, and a satellite emulator, enabled thousands of visitors to the Winter Olympics to connect via Wi-Fi or from a bus travelling at speeds of 60 kph to 80 kph, where record data transfer speeds of 5 Gbit/s were measured. Visitors also used virtual glasses to "travel" in real time and in 3D to a small town in Finland 14,000 km from Pyeongchang.

Leti, which was heavily involved in the development of these technologies, filed five patents and published five articles and conference papers.

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Day by day

Regenerbone bone reconstruction project could lead to startup

The team of researchers led by Catherine Picart at LMGP* recently began work on Regenerbone, an ERC Proof of Concept project with a grant of €150,000. The eighteen-month project will build on prior research on bone defect repair using an osteoinductive film. The new research will also address regulatory issues, raw-materials supply, and the business plan for a future startup.

Compared to bone grafts, whose use is limited to defects that are small in size, the osteoinductive material can be placed on a cylindrical implant to reconstitute bone fragments. It can be placed on implants made from titanium or PEEK polymer, two materials commonly used in bone surgery. LMGP has been developing the films for nine years and has published fourteen articles and obtained three patents to date.

A Grenoble Institute of Technology-CNRS lab

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Day by day

Grenoble Institute of Technology gets new Communications Director

Eliane Ferlay took the reins of Grenoble Institute of Technology's Communications Department at the beginning of February. Ms. Ferlay brings diverse career experiences (Alliade Habitat, the City of Albertville, Fondation Hôpitaux de Paris-Hôpitaux de France, etc.), including with multinational companies, and she is thrilled to come to higher education—a first for her. One of her priorities will be to strengthen ties with all of the school's academic and industrial partners.

Ms. Ferlay manages the existing communications team of six; a webmaster will soon expand the team to seven. The webmaster will help manage the back offices of the Grenoble Institute of Technology websites and support the development of the school's online communication.

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FAME Master's program strengthens ties with industry

With a ten-year history and some 200 graduates, the FAME (Functional Advanced Materials and Engineering) Master's program recently received the European Erasmus Mundus seal for the third time. The program, which is coordinated by Phelma with the support of seven European universities*, will be called FAME+ starting in September 2018.

The curriculum will focus heavily on the industrial research and development of advanced nano, hybrid, and ceramic materials. This is to give graduates the best possible career-placement prospects.

This year the FAME+ Partners Circle welcomed seven new industrial companies, seven new technological research organizations, and thirteen new universities—giving students even more opportunities for their internships.

**Grenoble Institute of Technology, TU Darmstadt, U. Aveiro, U. Augsbourg, U. Bordeaux, U. Liège, UC Louvain*

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Innovation: CEA still in the top-100 global innovators

For the seventh year running, Clarivate Analytics (formerly Reuters), has ranked the CEA among the top 100 global innovators. Only two other research organizations are on the list: Fraunhofer in Germany and ITRI in Taiwan. The rest of the ranking is populated by companies, including six in France: Alstom, Arkema, Safran, Saint Gobain, Thales, and Total.

The global top 100 is based on the organizations' patent activity and intellectual property strategy, including the number of patent filings and extensions and the success rate. The CEA is particularly active, with 762 priority patents filed last year, a slight increase from the 743 patents filed in 2016. Grenoble is by far the CEA's leading center, filing more than three quarters of the patents.

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Leti to organize HTA's tenth anniversary event in Brussels

Leti will organize a day-long event for the tenth anniversary of the Heterogeneous Technology Alliance (HTA) on April 24 in Brussels. The strategic alliance brings together four top-tier European research institutes Fraunhofer, CSEM, VTT, and Leti. HTA's members meet regularly to discuss their latest research, set up joint projects, and prepare joint proposals for EU projects. The alliance has been effective: Together the members of HTA have had more success than they would have going it alone.

Around 100 people—professionals from research, industry, and innovation—are expected to attend. Representatives of the European Commission have also been invited, which will give HTA members a chance to talk with them about priority research topics going forward.

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iGEM 2018 team tackles phagotherapy

Motivated by the success a team of students from Grenoble encountered at iGEM 2017, a new thirteen-member multidisciplinary team is already in the running for this year's iGEM (International Genetically Engineered Machine) competition in Boston. The team includes students in Phelma's Biomed program, the Pharmacy School's biotechnology program, students from business schools IAE and GEM, and a web designer.

The team's project focuses on phagotherapy, a potential solution to the problem of antibiotic-resistant bacteria. The team will design a functional prototype that can simultaneously detect the presence of pathogenic bacteria and the efficacy of phages against the bacteria detected. The system would use light to indicate which phages to select for therapeutic use.

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MINATEC a center for the arts and culture

Taking a cultural tour of the MINATEC campus has probably never crossed your mind. Maybe now it will! The Grenoble-Alps University community created the "*Campus des Arts*" program in 2017 to promote the cultural interest of MINATEC and other sites. The program's website lists some 40 works of art on Grenoble's campuses and offers up discovery tours with downloadable guides. The 90-minute "*Campus Ouest*" walking tour starts at IUT, near the train station, and ends at LSPC on rue des Martyrs near the Presqu'île tramway stop. Along the way you will see five works of art in a variety of media, including paintings, mosaics, and sculptures. All were created by contemporary artists and commissioned by the University under the French government's "1%" art acquisition grant program.

http://campusdesarts.fr/

Horizons

Exagan gets a warm welcome in China

It would be difficult to imagine a better way to enter the Chinese market: Grenoble-based startup Exagan, which specializes in power components for converters, was selected for the Impact China 2018 program run by Business France and Bpifrance. The program will send Exagan to China on three trips totaling five weeks, giving the company ample opportunities to determine which region of China would be best suited to its business and to make contact with potential customers.

China is a major producer of electric vehicles and consumer electronics, making it a key market for Exagan. The startup, which has 25 employees at sites in Grenoble and Toulouse, would have invested much more time and taken on much more risk going it alone in China. This program will position Exagan to set up shop in China and hire local employees.

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Interview

**Tony Prézeau,
Head of the Bibliometrics Department,
CEA Market Research Division**

"Innovation marketing demands agility and a willingness to challenge the status quo"

Why does technological research need innovation marketing?

Technology push is not enough, as evidenced by the fact that 85% of innovations are market failures. This occurs for several reasons, from the wrong target application or business model to social acceptability and regulatory issues. You can create the greatest patented technology in the world and not sell a single product or create a single new job. That's what we try to avoid.

Is innovation marketing an empirical practice or a full-fledged discipline of its own?

It is a well-structured discipline—one that is taught in Master's programs at Grenoble, Lyon, and Paris-Dauphine Universities. Innovation marketing is where technological what-ifs and the needs of industrial companies overlap. It involves in-depth research that takes us from the library out into the real world to conduct interviews. We also investigate uses, design, and prototypes and demonstrator systems, which are sometimes vital to helping our partners understand what we can offer them.

Do you ever just go on gut instinct or leave things to chance?

We are open to anything! Sometimes our industrial partners come up with applications we never would have thought of. And, at the showroom, a visitor can get excited about a demonstrator we never would have guessed would be a good match for their needs—and, conversely, a visitor can fail to see the benefits of a demonstrator we thought would be a perfect fit. We have to stay agile and be willing to challenge the status quo—a culture shared by all CEA researchers and that is truly a benefit in terms of the work we do.

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Horizons

Phelma students help spread the word about science

First-year students at Grenoble Institute of Technology-Phelma are playing a major role in orchestrating the second edition of Phelma's "*Partager la Science*" [Sharing Science] program as part of their first-year student projects.

Some of the students have been facilitating science experiments, while six others will organize the program's closing talk, which anyone can attend, on the afternoon of May 17 at MINATEC. All participants will be there, including 30 primary-school and 20 high-school students. The program includes science experiments, feedback on the activities that have taken place throughout the school year, a lecture, and a "science for all" performance. The performance, organized by four students, will feature the "Pepper's ghost" optical illusion technique.

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Aledia raises €30 million and welcomes Intel

Startup Aledia, which specializes in a 3D LED technology, has just completed its third round of fundraising, bringing in €30 million in fresh capital. In addition to the company's past investors, which include Ikea, the high-profile Intel Capital has now also joined the ranks of the company's investors. This new investor is evidence that Aledia's technology, based on forests of high-yield gallium nitride nanowires, offers substantial potential. The technology targets consumer markets like smartphones, laptops, tablets, and virtual-reality devices.

The influx of funds will position Aledia to invest more in R&D and purchase strategic equipment. The company also plans to hire around 20 new junior and senior employees for its Grenoble site. The company will also maintain its joint R&D activities with Leti.

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Live from MINATEC

Malicious virus disrupts service at H1 cafeteria

On March 16 the experimental "clean station" set up in H1 to decontaminate USB memory sticks created some serious mayhem at the cafeteria. Following routine computer maintenance, the computer that runs all of the kitchen equipment was inadvertently connected to the clean station, which is likely how the malicious virus spread. Slippery as an eel, the virus created a whale of a problem that affected the entire kitchen. The bar's coffee maker got stuck on standby, the ovens overheated, bread mixers wouldn't mix, and the deep fryers were out of order.

Thankfully, the IT Security team rapidly identified the virus and all equipment was soon up and running again. The kitchen staff had to play catch-up, rushing to prepare the day's fare. Customers were blissfully unaware of the incident, enjoying their meals as happy as clams. The clean station was modified and no longer accepts any third-party connection requests.

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New arrivals at the CEA now have their own welcome packet

Since the end of March, all new arrivals—whether they are PhD candidates, temporary or permanent employees, or interns—at the CEA in Grenoble have been given a new welcome packet to help them settle in more comfortably. The information in the welcome packet was previously available online, and is now easy to find in a practical 72-page paperback-format booklet, currently available in French only.

The welcome packet contains comprehensive information on administrative procedures, safety and security, computing, human resources, working conditions, dining, travel, services, useful contacts, and a map of the campus. Everything new arrivals need for successful orientation! The information in the electronic version (available online) and in this new print version will be updated regularly. The packet will be used by nearly a thousand new arrivals each year!

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Live from MINATEC

BHT: Weebit Nano, a new company with great memory

Israel's Weebit Nano, which moved into the BHT in September, has been working with Leti since 2016. Their research focuses on tomorrow's resistive memory (ReRAM), which is faster and more energy-efficient than flash memory. ReRAM also offers the advantage of being made from silicon oxide, a material very commonly used in microelectronics and easy to integrate into CMOS processes.

Several key prerequisites to industrial scale-up have been completed. Most recently a set of 4,000 40 nm memory points was produced. Based on these encouraging results, Weebit Nano set up a French subsidiary at the end of 2017. ReRAM will be used in a number of applications, including high-density storage for servers and microcontrollers for IoT devices.

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2018 CEA Tech showroom guide now available

The 2018 CEA Tech showroom guide was published in February. The first edition of the guide came out last year. The guide, for internal use only, is designed for showroom tour leaders and business developers at the CEA Tech institutes. With nearly 300 pages of information, the guide is also a practical reference for trade shows.

Written in non-technical language, the guide describes the 89 prototypes and demonstrator systems on display in the showroom and the associated CEA Tech R&D capabilities. For each prototype or demonstrator system, the guide reviews the technologies used, the markets and applications targeted, benefits, existing partnerships, and development opportunities.

Nearly 600 tours of the showroom were given in 2017, 250 of which were for professionals from industry. The guide, in French, will be a crucial resource for the staff conducting the tours.

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Ground breaks on BHT2

Construction of the new High-tech Building, BHT2, is well underway. The building, located at the southern entrance of the Presqu'Île district on rue Félix-Esclangon, is slated for completion in the spring of 2019.

The five-story high-environmental-quality building will offer modular office, lab, and cleanroom spaces from 50 sq. m to 900 sq. m. dedicated to development activities in the fields of micro and nanotechnology, biotechnology, medical technology, and energy. BHT2 will be fully operational in a year. The building will house innovative companies and startups that have formal agreements with MINATEC research organizations. Like BHT1, the new building will support the development of technological research and will help support the Nano 2022 project.

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Agenda

April 10,
Conservatoire de Grenoble
Musisciences 2018
concert by Grenoble Institute of Technology student musicians
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April 16, Phelma
Lecture on artificial intelligence
organized by Best Grenoble
Contact: grenoble@BEST.eu.org

April 24, Brussels
Heterogeneous Technology Alliance tenth anniversary event
Organized by Leti
Contact: yannick.letiec@cea.fr
http://www.hta-online.eu/

May 17,
MINATEC Auditorium Z
Closing conference of the "Sharing Science" school outreach program
Contact: aurelien.kuhn@phelma.grenoble-inp.fr

June 21–22,
Maison MINATEC
French American Workshop
hermine.vincent@cea.fr

July 2–4, Phelma
Fifth edition of the Introductory Course on Magnetic Random Access Memory
www.inMRAM.com

July 3-4,
Open Lab – CEA
Ideas Days 2018: Innovation to fight climate change
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July 4–5,
CEA Grenoble
Leti Innovation Days
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July 11–12, Phelma
2018 course on teaching college-level physics
https://eps2018.sciencesconf.org/

April Fools!

You guessed it! This issue's April Fool's article was about the malicious virus at the H1 cafeteria. While the clean station set up to find viruses hidden in USB memory sticks does exist, it has been designed not to contaminate other PCs. Plus, the kitchen equipment is actually run by humans, not computers. By the way, did you know that the French expression for April fool's, *poisson d'avril*, means "April fish"? The origins of the expression are obscure, but the "April fish" is now a well-anchored tradition in France. We hid three fish-related words in the article. Can you find them?

Contacts

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