MINA-NEWS
#65
MINATEC
NEWSLETTER
JUNE 2021

TOP NEWS

Could neuroillumination be Clinatec's new weapon against Parkinson's disease?

Exposing degenerating neurons to near infrared light could slow the progression of Parkinson's disease. A preclinical trial of this approach in 2016 produced excellent results. The first patient in a new clinical trial was implanted with the neuron-illuminating device at Clinatec at the end of March.

Parkinson's disease affects 6.5 million people worldwide. Although treatments—like the deep brain stimulation invented by Dr. Alim-Louis Benabid in the 1990s—can temporarily alleviate the symptoms of Parkinson's, there is currently no way to slow the progression of the disease.

A FOUR-YEAR TRIAL ON A COHORT OF FOURTEEN PATIENTS

Developed by Grenoble-Alpes University Medical Center with university labs, the CEA, and Boston Scientific, the treatment is creating new hope now that clinical trials have started. Illuminating degenerating neurons with near infrared (NIR) light has long-lasting biological effects, slowing down the once-irreversible process, which, if left unchecked, leads to the progressive loss of motor function in the patient.
Grenoble-Alpes University Medical Center's Dr. Stéphan Chabardès, who also runs the medical unit at Clinatec, implanted the neuro-illumination probe in a 55-year-old female patient on March 24. The patient will be monitored for four years. Hospitals in Lyon, Marseille, and Créteil are helping to recruit the additional thirteen patients needed for the trial.

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INNOVATION

DNP probes cellulose nanofibrils

Dynamic nuclear polarization, or DNP, can make solid-state NMR several times more sensitive. Researchers at Irig have been developing the technique to gain new insights into the surface chemistry of cellulose nanofibrils onto which an active molecule had been grafted.

They were able to distinguish between adsorption and covalent grafting, which allowed them to quantify the active molecules present. They also detected several residual compounds—the pre-oxidation agent, depolymerized cellulose, and coupling agents—resulting from the formation and functionalization of the nanofibrils. This new information will help the scientists* Irig is working with to study the nanofibrils to improve their processes.

**Centre technique du papier (pulp and paper research lab), LGP2, DPM, Cermav*

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Advances towards more "human" magnetoencephalography temperatures

Magnetoencephalography (MEG), a functional brain imaging technique, uses SQUIDs cooled to 4 K and placed at a certain distance from the patient's cranium. Alternatively, alkaline-based sensors heated to 150 °C and also placed at a certain distance from the patient, are used. CEA-Leti has come up with a third way: sensors that use helium-4 gas excited to a metastable state as their sensing element. The advantage is that these sensors operate at room temperature and can therefore be placed in contact with the cranium, very near the signal to be detected. An initial prototype made up of five sensors was developed and tested at two university hospitals. The results were published in *Optics Express*.

This technology is easier to install, use, and maintain, which could help bring high-end imaging to the masses. Startup Mag4Health was founded to develop and commercialize the solution.

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Nitrogen magneto-ionics for lower power consumption

Magneto-ionics, or the voltage-controlled transport of atoms in and out of a magnetic material to alter the material's properties, is a relatively new discipline. Irig researches are part of an international team* that recently made an important breakthrough. Rather than displacing oxygen atoms, which are widely used in magnetic layers, the researchers utilized nitrogen, which activated or deactivated the material's magnetism with just half the voltage. Plus, the process is reproducible and faster than with oxygen ions. The potential energy savings could be significant.

Irig completed the simulations, which turned out to be consistent with the results observed in the lab. The research was published in *Nature Communications*.

**Barcelona and Georgetown Universities, Helmholtz-Zentrum Dresden-Rossendorf in Dresden, National Microelectronics Centres CSIC in Madrid and Barcelona, the Catalan Institute of Nanoscience and Nanotechnology*

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MINATEC®
MINA-NEWS is published by MINATEC,
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A step closer to multi-time-scale neuromorphic chips

CEA-Leti is coordinating the European MeM-Scales project, which kicked off in early April. The focus? Neuromorphic chips capable of learning on several time scales. These brain-inspired chips can learn simultaneously at millisecond intervals (axon transmission), at second intervals (spoken language), or at much longer intervals (motor skills).

The nine-partner project consortium is working on autonomous learning algorithms and memory and device technologies. CEA-Leti is contributing its know-how to new resistive-filament and phase-change memory solutions with excellent "forgetting behavior," a prerequisite for this kind of multi-time-scale application.

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Could the surfaces of semiconducting nanowires be the key to performance?

When it comes to the performance of semiconducting nanowires, much progress is still to be made, mainly because the nanowires' surfaces have not been optimized. LMGP, IMEP-LaHC, and two Paris-based labs* are addressing the fundamental surface changes that affect semiconducting nanowires. Their work is part of the ANR (French national research agency) Scenic project, which runs through 2024. The scientists will characterize, functionalize, and optimize the surfaces and, ultimately, prototype a piezoelectric device with output voltage well above current values.

Specifically, they will work on nanowires made from two materials with the same crystallographic structure, zinc oxide and gallium nitride, and that are easy to compare. A nanowire 50 nm in diameter and 1 µm long has a surface area of more than 150,000 nm^2.

**C2N (CNRS, Saclay) and Geeps (Supélec, Gif-sur-Yvette)*

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Wafer-level testing of photonic circuits speeds up development

Optically-coupled photonic chips cannot currently be tested at wafer level. Instead, they must be cut, packaged, and then tested individually. CEA-Leti successfully demonstrated an automated testing solution that removes this hurdle. A custom probe from Teem Photonics ensures very broad bandwidth and unparalleled measurement dynamics of more than 60 dB. It is capable of characterizing virtually all optical components.

The probe just needs a track in the silicon substrate measuring a few hundred microns in depth to operate. This method could remove a significant barrier to scaling up wavelength multiplexing circuits for manufacturing. The advance is one of the results of the European Masstart project, which runs until the end of 2021.

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Bioimaging: quantum dots with fluorophore-like performance

Regular quantum dots are more stable under optical excitation than organic fluorophores; however, the dots cannot be used in biological environments because they can contain toxic metals like cadmium and lead. Several teams of researchers at Irig are putting their heads together to overcome this hurdle. They synthesized core-shell quantum dots that contain three non-toxic metals: silver, indium, and sulfur. Then, to enable the development of biosensors that emit in the near-infrared spectrum, they functionalized the shells with single-stranded DNA sequences.

The quantum dots are biocompatible and as good as the best fluorophores in terms of photoluminescence efficiency. A PhD research project slated for completion in 2023 is tackling further improvements to the synthesis process and biological use cases.

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NB-IoT: some adaptations for satellite communications

One of the main IoT communication protocols, narrowband IoT, could, with a few minor tweaks, be used for satellite links. A recent study by CEA-Leti for CNES, France's national center for space studies, leveraged simulation techniques to show that it is possible for a constellation of satellites orbiting a few hundred kilometers above the Earth to connect to several million objects with transmission speeds of a few kilobits per second. The downside is that the Doppler effect (a function of the speed at which the satellite is traveling) must be managed.

Satellite NB-IoT communications could prove useful wherever terrestrial base stations are lacking, such as in sparsely-populated rural areas and in the oceans, for example. In this study, the researchers also determined the waveform parameters best suited to this new scenario.

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Lensless imaging could make phage therapy faster

Researchers from CEA-Leti, Irig, and LTM recently worked with a team in Lausanne* to develop a lensless device capable of reducing the time it takes to identify active phages on antibiotic-resistant bacteria at least threefold. The large-area image sensor (24x36 mm^2) reads the optical signature of areas occupied by bacterial debris. The technique could be more effective than naked-eye observation and would result in fewer false negatives.

An ANR (France's national research agency) priority program to develop the technique further is about to begin in conjunction with *Hospices civils de Lyon*, a major university medical center. According to the WHO, antibiotic-resistant infections could cause 10 million deaths per year by 2050, making phage therapy a strategic solution.

**Lausanne University Medical Center (CHUV) bacteriophage and phage therapy lab*

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Antibody engineering: CEA project wins Sanofi award

For the past several years, Institut Joliot (CEA Saclay) and Irig have been working together to combine their Polaris(MD) multi-scale molecular simulation and BigDFT massively parallel quantum chemistry codes. Pharmaceutical company Sanofi deemed the project worthy of one of its iTech Awards, and will fund research to apply the approach to an antibody-antigen complex to study the impact of mutations.

Polaris(MD) and BigDFT provide a biologically, chemically, and physically coherent description of this type of molecular complex. Based on the same input data, the two codes can eliminate any uncertainties associated with the choices made during the modeling process. The analysis focuses on observable phenomena and their variability.

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Quantum: CMOS withstands very low temperatures

In the future, quantum devices cooled to 10 mK will be used together with conventional electronics. Which raises the question of how well CMOS components, designed to operate at ambient temperature, hold up in temperatures close to absolute zero. To test out this scenario, researchers from Irig and CEA-Leti made hybrid circuits with the two technologies.

First, they evaluated a conventional CMOS TIA*, measuring currents in the picoA range. The circuit was able to withstand the cold, but its bandwidth was under 4 kHz.

The test was done on a 28 nm FDSOI circuit. To increase measurement speeds, improvements will have to be made to the design. As the research progresses, other CMOS circuits will be evaluated for quantum applications.

**transimpedance amplifier*

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DAY BY DAY

Startup Vulkam sets sights on space market

Since the beginning of the year, Vulkam, a startup founded by a SIMaP scientist in 2017, has secured two space-related R&D contracts with Thales and LYNRED. The company develops ultra-insulating materials that offer remarkable performance.

Specifically, Vulkam develops amorphous metal alloys, Vulkalloys®, whose atoms are reordered in such a way as to optimize a given property (like mechanical resistance, for instance) for record-breaking performance. These materials are then used to precision-manufacture small metal parts accurate to within microns. The company currently offers around 20 off-the-shelf products and can develop specific materials for the watchmaking, medical, aeronautics, and defense markets. Vulkam is still working with SIMaP through an R&D partnership.

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Aryballe to receive €1.1 million subsidy for new pilot line

Aryballe was selected to receive €1.1 million under the French government's economic stimulus program. The company raised €7 million in 2020; the additional funds will allow Aryballe to complete its pilot production line in a 120 sq. m clean room in Grenoble. The pilot facility will produce low-cost, miniaturized, universal odor sensors starting in early 2022. And, once it ramps up to full capacity, some 2 million units per year will come off the line. The facility will ultimately employ around 40 people.

Aryballe's technology effectively reproduces the human sense of smell by combining biochemistry, advanced optics, and machine learning. With potential applications in the flavoring and fragrance, automotive, public transportation, and home appliance markets, the startup's prospects are excellent. Aryballe continues to work with CEA-Leti on R&D under a joint lab.

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New Masters in Biorefining and Biomaterials

The Masters in Materials Science and Engineering at Grenoble INP - Phelma, UGA has added a new specialization: Biorefining and Biomaterials. The focus is the conversion of biomass into environmentally-friendly synthetic gas, hydrocarbons, cellulose fibers, biosourced cosmetics, and biomaterials.

The curriculum covers all stages of the transformation process, from plant material to fibers, and, finally, to biomolecules. All courses are taught in English. It is a joint program offered by Phelma with Grenoble INP - Pagora, UGA.

The Covid-19 pandemic did not prevent the program from getting off to a strong start: The inaugural cohort had eleven students, including ten international. The teaching team would like to double the incoming class next year and, ultimately, accept 32 students per year. The goal is to respond to growing demand from businesses seeking these competencies.

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Vincent Favre-Nicolin wins award for his work in crystallography

Over his career, Vincent Favre-Nicolin, a UGA faculty member who conducts research at ESRF, has developed open-source software applications that are widely used by crystallographers. *L'Association française de cristallographie,* France's learned society for crystallographers, will give Vincent its biannual André-Guinier Award on July 2.

The Fox software Vincent developed in the 2000s, which uses powder diffraction patterns to determine the structure of crystals, is still relevant today. Pharmaceutical researchers, for example, use it to solve the 3D structure of molecules when developing new drugs. And the PyNX software suite, initially released in 2018, processes coherent X-ray imaging data. The ESRF EBS (Extremely Brilliant Source), which has improved the coherent photon flux by two orders of magnitude, is creating even more opportunities to use this software.

More on Fox: http://fox.vincefn.net/
More on PyNX: http://ftp.esrf.fr/pub/scisoft/PyNX/doc/

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IMEP-LaHC scientist travels to Finland for six-month stay

Jean-Emmanuel Broquin, who is in charge of tech transfer and partnerships at IMEP-LaHC, arrived in Finland in mid-May for a six-month stay at the University of Eastern Finland in Joensuu. An expert in integrated photonics, Jean-Emmanuel will work on the 3D hybridization of glass, silicon, and III-V technologies. His other activities will include attending scientific conferences, meeting with investors, and giving talks to the general public.

His stay is made possible by the Nokia Foundation-*Institut français de Finlande* Chair of Excellence that marks the start of a long-term partnership between Finnish researchers and IMEP-LaHC with the potential to generate joint laboratories, research collaborations, publications, joint applications for European projects, and more!

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PASCALE BAYLE-GUILLEMAUD
Deputy Director, Irig

"With four Equipex grants, we have done exceptionally well"

MINA-NEWS: The French government has selected four Irig joint research units to receive Equipex grants. What does this mean for Irig?
Pascale Bayle-Guillemaud: Our success rate has never been higher. We really have done exceptionally well. The grants will finance equipment that is crucial to programs in Irig's key research areas. Investments will include the beamlines at ESRF, cryomicroscopy equipment, and materials for spintronics research.
Being awarded four of the grants underscores our position in the national scientific community. And it means that we have an obligation to work for the national scientific community through broader platforms and set national ambitions and not just local ones.

MINA-NEWS: But magnetic materials are a local specialty, aren't they? With Spintec driving advances?
PB-G: Of course Grenoble is a center for magnetic materials. But our future pilot line, which will make materials for academic research in spintronics, will be built at the PTA (upstream technology platform), one of five major centers in the national Renatech network. We will also purchase instrumentation for 2D magnetic materials and heterostructures as part of a national cluster.

MINA-NEWS: The "French" beamlines at ESRF and IBS will also benefit from the grants, right?
PB-G: The five lines at ESRF that we operate in a CRG* with CNRS will get upgraded optics and computing resources. With the EBS project, we now have the brightest light source in the world. So, upgrading the associated optics and computing was not something that could wait. Last, for our biology research, IBS will get a state-of-the-art electron cryomicroscope as part of a national research infrastructure called FRISBI. ■
**Collaborative Research Group*

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HORIZONS

Middle-school science competition garners 350 entries

A total of ten CEA scientists and technicians gave GIANT's *"Affiche ta science"* poster competition a helping hand this year, traveling to fourteen middle schools across the Isère district to talk about their careers. They also gave presentations on specific topics like microfluidics for medical applications, clean vehicles, low-temperature technologies, and cryogenics for space. The 350 participating students then paired up to produce either a poster or video on the topic presented to their class. The best posters and videos from each class were entered into the competition, which will culminate with a 100% online event on June 10. The program will include a talk by Phoenix Mobility (which makes a retrofit kit to convert fuel-powered vehicles into electric vehicles) and a virtual tour of the CEA showroom. The winners of the competition will also be announced, of course.

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Osiris robotic irrigation system could help make farming more sustainable

Once upon a time there were three engineers, and all three came from farming families. One day, they decided to invent a smart, autonomous robot to help farmers spend less time irrigating, fertilizing, and protecting their crops. They also wanted the robot to make more economical use of water and agricultural inputs. The name of this (true!) story is Osiris Agriculture, a startup cofounded by Grenoble INP - Phelma, UGA 2020 graduate Léon Guyard.

A prototype of Osiris will be tested this summer in France's Oise district on a potato crop. The time and water saved will be calculated by comparing Osiris' crop with a neighboring crop watered using conventional methods. If the prototype works, the company will raise funds to scale the technology up for manufacturing. Osiris Agriculture would like to see five systems in service by 2022 and 40 by 2023.

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LIVE FROM MINATEC

Fab lab encourages engineering students to "do it yourself"

The new fab lab at Grenoble INP - Phelma, UGA is home to an array of computer-controlled and other equipment including 3D printers and machining, folding, and cutting tools. Students will find everything they need to build whatever they need for their engineering projects at the fab lab! the 50 sq. m lab on the fifth floor of the Phelma building is managed by Jean-Paul Robert, who was brought on to get things up and running.

His mission is to help engineering students "learn by making," specifically by showing them how to use the tools correctly and safely. Whether a student needs to build an axis, housing, turbine, propeller, or plastic part, it is sure to become a valuable educational activity at the fab lab.

The school's original fab lab, which is about half the size of the new one, is still open and will be used for more complex, hazard-prone experiments that will be carried out solely by the lab manager.

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Graphene2021 Conference: in October, and ideally in person

The Graphene2020 conference had to be held remotely, but it still brought in 580 attendees. This year's conference will be held in person on two sites, the World Trade Center Grenoble and MINATEC, from October 26 to 29, 2021

The plenary sessions will feature the internationally-renowned Philip Kim of Harvard and Klaus Müllen of the Max Planck Institute. The program will also include workshops on 2D materials' topological properties, applications in the field of health, simulation and theory, and characterization—topics that reflect the wide-ranging nature of this particularly fast-paced field.

Grenoble's scientific community, very active in 2D materials, will get a boost from this major event. Scholarships will be available for international students.

Learn more: http://www.grapheneconf.com/

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Louis Néel in the spotlight for golden anniversary of his Nobel Prize

On June 10 and 11—exactly 50 years and six months from the day Louis Néel won the Nobel Prize in Physics—Grenoble's scientific community will revisit his career. The event was originally slated to take place in December 2020, right in the middle of the Covid-19 pandemic. The rescheduled two-day event will likely be online-only so that anyone can attend. Bernard Dieny of Spintec and Alain Schuhl of CNRS will be among the dozen speakers who will pay tribute to Louis Néel, the scientist and the man. The program will address the current state of the art in magnetism, the field in which Néel's work was seminal, and highlight the major role he played in establishing Grenoble as a major center for scientific research. Activities commemorating Néel's Nobel Prize will continue into 2022, including during France's national science week.

View the program and register at: http://neel50nobel.fr

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Student radio spreads good vibes

In September, three students from Grenoble INP - Phelma, UGA and a musicology student from UGA started a club, called *Radio Plaisir,* to help fill the void left by students' social lives, interrupted by the pandemic. Every Wednesday evening, they go live on streaming platform Twitch.tv. The recordings are then dispatched to social media. The idea of starting a radio station came from Matthieu Saussaye, who wanted to create a platform for entertaining and informing students about the arts (through music and book segments) and entrepreneurship. Each broadcast features interviews with Grenoble-area entrepreneurs, mainly the founders of tech startups (like Optimergo, Abelio, and Reveho), with the goal of encouraging engineering students to become entrepreneurs themselves.

https://www.facebook.com/plaisir.radio

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CEA raises awareness of gender-based violence

Gender-based violence can take many forms, including seemingly-harmless comments that, when they occur in the workplace, are actually damaging expressions of gender discrimination. In February of this year CEA Grenoble initiated an awareness-raising campaign scheduled to run into 2022. In addition to raising overall awareness of gender-based violence, the campaign will also include factual information about what the law says, testimonials from people who have witnessed or been the victims of this kind of violence, and recommendations on how to respond.

The highlights of the campaign are a series of incisive posters on topics like gender-based nicknames, gender biases with regard to certain professions, and situations where "ordinary" behavior crosses a line; two 20-minute online classes that have been available to all CEA Grenoble employees since March; and several activities facilitated by a theater company.

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MINATEC Enterprises gets a new office and CEO

Some changes have been made at MINATEC Entreprises in response to a directive in France's Notre Act of 2015 that transfers responsibility for economic policy from the national to the regional government.

Yannick Neuder, Vice President of the Auvergne-Rhône-Alpes Regional Council, has succeeded Annick Merle (Vice President of the Isère General Council) as CEO of MINATEC Entreprises. Ms. Merle will serve as Vice President, MINATEC Entreprises with Guy Jullien (Grenoble Alpes Métropole) and Jean-Charles Guibert (CEA). In other news, Pierre-Édouard Cardinal has succeeded Alain Ramberti as Chief Operating Officer.

The new management team will focus on the pressing issue of what to do about the BHT3 building. The BHT1 and BHT2 buildings have been completed and the decision to build BHT3 has been confirmed. However, a timeline and other operational questions still need to be addressed.

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AGENDA

June 10 [online]
LAST DAY OF STUDENT SCIENCE COMPETITION
Affiche ta science ! for middle-school (French *4e*) students
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June 10 and 11 [online]
COMMEMORATION OF THE 50th ANNIVERSARY OF LOUIS NÉEL'S NOBEL PRIZE IN PHYSICS
See the program and register at: *http://neel50nobel.fr*
contact@neel50nobel.fr

June 22 [*Stade des Alpes* stadium]
JOB BRIDGE
Student-company meetings
https://www.minalogic.com/evenements/job-bridge/

June 22 and 23 [online]
LETI INNOVATION DAYS
https://www.leti-innovation-days.com/

June 29 [online]
HLF CONNECT BRIEFING
Two interactive panel talks on the "reinvention of industry to support a resilient society"
Register online: *hlf-giant-grenoble.org*

July 1 [World Trade Center Grenoble]
FORUM 5I
INVENTING TOMORROW'S WORLD
New perspectives on collaboration, workspaces, and tools
https://www.forum5i.fr/

September 20 to 28 [Chichilianne and Grenoble]
CRYOCOURSE 2021: ADVANCED EUROPEAN SCHOOL ON CRYOGENICS
http://cryocourse2021.grenoble.cnrs.fr/

October 26 to 29 [World Trade Center and MINATEC]
GRAPHENE2021 CONFERENCE
http://www.grapheneconf.com/

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