MINA-NEWS
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A €43 billion European plan for semiconductors

In February, the European Commission confirmed its massive €43 billion semiconductor industry plan. €11 billion has been earmarked for research on the most advanced chips and new pilot manufacturing lines. CEA-Leti is expected to play a major role in the plan.

The European Chips Act announced in February rivals the US's support for the semiconductor industry. The legislation hasn't gone before the European Parliament yet, and the Union's 27 Member States still have to weigh in. But there are several reasons to be optimistic, especially in terms of the plan's impact on Grenoble. The most advanced chips are front and center in the plan's strategy, and FD-SOI, a technology originally developed at CEA-Leti, plays a predominant role.

NEW FD-SOI PILOT LINE IN GRENOBLE PLANNED

To a large extent, the Chips Act mirrors the preliminary document drawn up at the end of 2021 by CEA-Leti, Imec, and Fraunhofer at the request of the European Commission.

The document mentions a new FD-SOI pilot line to be built in Grenoble to help scale up 10 nm FD-SOI. Today, STMicroelectronics manufactures chips on the substrate, but using 28 nm technology.

The plan now has to be made official through agreements at the EU and national levels.

The semiconductor shortage is wreaking havoc across the economy—a good reminder of how important R&D and innovation are to the industry.

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INNOVATION

A new generation of earphones just over the horizon

Microsystems experts at TIMA and G2ELab have been working on little-known objects called squamous transduction earphones since late 2021. These innovative earphones have an actuator that vibrates the cartilage of the ear, turning the auricle into an audio speaker.

The researchers are working with a corporate partner and with startup ActivMotion, which designed an initial version of the actuators and is already commercializing products.

The disruptive technology the two labs were able to produce together will enable a new gen-eration of earphones.

Transduction earphones offer much better sound quality than the bone conduction ear-phones currently on the market. They also emit sound in stereo, improving the quality of direc-tional information.

This project was part of a contract with the DGA (France's military procurement agency).

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Inspired by the locust nervous system, Élisa Vianello's research wins ERC grant

Élisa Vianello, who heads CEA-Leti's embedded AI program, won a €2.8 million ERC Consolidator Grant. Disbursed over five years, the grant will fund research on computing architectures inspired by the locust's nervous and sensory systems.

The locust escapes from its predators by processing information about imminent danger "locally" in its legs. No time is wasted sending information to the brain, which explains the insect's extremely rapid flight response.

This kind of local processing should enable the development of powerful, energy-efficient nanosystems. Currently, there is no "perfect" memory. One of the objectives of the research is to build a hybrid synapse leveraging different memory technologies.

The results of this research will be of interest for self-driving vehicle, drone, and robot systems.

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Gingko biloba protein used in multilayer nanomaterial

Gingko biloba trees, known for their longevity and medicinal properties, are now being used in nanoscience. Two teams of researchers a Irig used the plant's LEAFY protein, which is involved in flowering, to develop a 40-layer nanomaterial made up of cells spaced 8 nm apart. The perfectly aligned cells offer excellent mechanical resistance and molecular grafting can be used to functionalize them. It would be impossible to obtain such a small and regular 3D structure using conventional techniques like etching or the elementary assembly of atoms.

Irig now has a versatile nanomaterial with potential uses in biotechnology, nanoelectronics, biocatalysis, and biosensors.

The researchers will start with VOC detectors* expected to be ten times more sensitive than the current state of the art.

**Volatile organic compounds*

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Piezoelectric effects investigated at the nanometric scale

The ANR (French national research agency) Latino project has been looking at how mechanical-to-electrical conversion processes work at the nano scale since the beginning of March in research conducted by IMEP-LaHC, LMGP, IM2NP (Marseille), and the Soleil synchrotron. The partners are employing several techniques not generally used for this kind of research to study zinc oxide (ZnO) nanowires, combining *in situ* nanomechanical tests and X-ray diffraction.

At the nano scale, the ZnO yield strength increases, which should boost non-linear piezoelectric effects and flexoelectric* effects due to non-homogeneous strain distribution.

It is not yet known whether these effects positively or negatively impact energy conversion.

**Induced by a deformation gradient*

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Pushing back the limits of quantum error correction codes

Polar codes, invented in 2009, are a particularly promising breed of error correction code with a wide range of potential uses. The codes were used in a PhD research project at CEA-Leti and Grenoble computer science lab LIGLAB to develop quantum-specific polar codes.

In this research, the polar quantum error correction codes corrected noise (represented as a quantum channel) induced by the interactions between the qubits and their environment. The codes developed perform at the theoretical limit of redundancy specific to quantum channels.

They can also address one of the major challenges of the coming years, which is error-correcting codes for computing, a much more complex process that will require fault-tolerant implementation of the codes.

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ESRF X-ray imaging looks inside the platinum in catalytic converters

Researchers at Irig* leveraged ESRF X-ray imaging, simulation, and a neural network algorithm to characterize the deformations in platinum nanoparticles similar to those used in catalytic converters—a first.

The *in operando* observations were completed on model particles in contact with carbon dioxide, and measurements were taken on a cycle over twelve hours. The observations and measurements resulted in the identification of two types of defects: rearrangements of atoms in the platinum crystals, and the formation of flat facets on previously rounded areas.

Now the researchers are working on assessing the defects' impact—positive or negative—on the reaction. The results should lead to engineering work to improve catalytic converter efficiency.

**With other researchers from France, Israel, and the Netherlands*

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Could hole qubits be the future of quantum?

Nobody knows whether tomorrow's silicon qubits will be electron qubits or hole qubits. If this exciting new research by an Irig PhD student is any indication, the suspense is going to go on a little longer!

This major research showed that hole spin can be manipulated and read based on detailed characterization of the hole spin's energy spectrum, even when the quantum dot (QD) isolating the hole is at the center of a dense QD array. Unlike electron qubits, which can only be manipulated with an RF magnetic field, hole qubits can be manipulated with a simple radio frequency (RF) electric field—the basis for the demonstration carried out in this research.

Hole qubits are more difficult to fabricate than electron qubits, but they are promising, and Irig is pursuing the research. Up next: The researchers will couple a qubit with a single photon to make a quantum photon bus.

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Keeping bacteria at bay in the fishing and fish farming industries

Active bacteria on industrial surfaces can turn into viable but non-culturable cells (VBNC) under major stressors like disinfectants. VBNCs don't grow in Petri dishes but are considered live bacteria and can contaminate food and even become active again later.

A PhD student at CEA-Leti is developing a VBNC detection method for the fishing and fish farming industries.

Combining spectroscopy and stable isotope labeling, the method has produced encouraging results on *Listeria monocytogenes* VBNC.

Plus, it is probably applicable to other bacteria, like *Escherichia coli* and Vibrio.

The research won a Best Poster Award at the 2021 French Society of Microbiology conference.

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Magnetic microparticles could fight cancerous tumors

For the past decade, two teams of researchers at Irig* have been investigating how to destroy tumors by injecting and then vibrating magnetic microparticles with an alternating magnetic field. One obstacle stands in their way: It takes too long to produce the perfectly calibrated disc-shaped microparticles. So, instead they used micrometer-sized grains of ground iron oxide powder functionalized with polyethylene glycol.

The production yields are 1,000 times those of the microparticles. In *in vitro* testing, the grains dispersed better in the tumor, causing apoptosis, or spontaneous death, of the cancer cells, rather than necrosis, which is more likely to cause the tumor to metastasize. The objective of the research, which is ongoing, is to bring the solution through clinical trials.

**Spintec and SyMMES*

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DAY BY DAY

LMGP Hires MXenes specialist

Hanna Pazniak, an expert in MXenes, joined the LMGP nanomaterials and advanced heterostructures team in early 2022.

MXenes, made by exfoliating precursors (MAX phases), are two-dimensional compounds that, depending on their composition, offer a variety of properties, from large specific surface to excellent electrical conductivity and elasticity. They can also be used to make functionalized and hydrophilic surfaces. LMGP is one of the only laboratories in the world to able to synthesize single-crystal MXenes.

Research on MXenes in perovskite solar cells figures prominently among Pazniak's many publications. With a career that has taken her from Russia to the United States and Germany, Pazniak brings a broad international network—and the potential for new research partnerships—to her new team.

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Soitec now a major Grenoble INP - Phelma, UGA partner

Grenoble INP - Phelma, UGA signed its first partnership agreement with innovative semiconductor materials giant Soitec. Michael Fièvre, Director of Soitec's Bernin factory and Phelma alumnus and board member (since 2021), helped get the agreement finalized after Covid-related delays.

The purpose of the three-year partnership is to ramp up cooperation between Phelma and Soitec around degree programs in microelectronics and materials. With activities like job fairs and mock interviews, the partnership will also be instrumental to career placement for students enrolled in Phelma's Materials Science and Engineering (MSE) and other programs. The international Advanced Materials and Nanotech programs will also benefit.

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Celebrating two decades of spintronics at Spintec

Spintec, founded in May 2002 with a team of twelve researchers, is behind many advances in spintronics. The lab helped drive the emergence of MRAM memories and spin-orbitronics and has filed more than 80 patents and spun off four startups, three of which are still in business today (Crocus Technologies, Hprobe, and Antaios). And the original staff of twelve has grown to around 100!

A twentieth anniversary celebration will be held on May 10 at the MINATEC auditorium.

In the morning, former Spintec directors, team members, and alumni will share their memories of Spintec's exciting history.

In the afternoon, the Spintec alumni network, open to PhD students and postdocs, will be officially inaugurated. Attendees will also get a chance to tour Spintec. A live webcast and recording of the event will be available.

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A 2,500 km solar bike tour through the Alps

GIANT is co-organizing the start of the Sun Trip Alpes 2022 bike tour on June 17, when 50 cyclists will depart from Y.SPOT Partners for a 2,500 km loop through six countries with a stop in Innsbruck, Austria and a final stage that will end in Lyon on July 9. The solar-powered electric bike adventure is not a race, but it does present a formidable technical chal-lenge.

The participant-designed bikes have to be no more than 1 meter wide and 6 meters long. Phelma alumnus Emile Rivoire will represent the GIANT Campus-Hexatech team.

Sponsors like Natura Vélo are helping Rivoire come up with a custom electric gravel bike.

Local startup E-Bike Lite will provide a Gboost motor, and solar panels made by CEA-INES will be mounted behind the seat and in front of the handlebars.

Riders will present their bikes at a special kickoff event on the afternoon of June 16 at Maison MINATEC. Join us!
https://www.thesuntrip.com/sun-trip-alpes-2022/

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INTERVIEW

YOULA MORFOULI
Head of the International Masters in Nanotechnology program

"Our students are interested in companies that can demonstrate a commitment to sustainability."

MINA-NEWS: The third Sustainable Electronics Work-shop* was held in February. What are your key takeaways?
Youla Morfouli: Around 60 students—ten from GEM—attended and I was particularly impressed with their level of motivation. All stakeholders, and not just engineers, need to address sustainable electronics and the technology's environmental and societal impacts. STMicroelectronics once again mobilized three of their top managers for the workshop. IoT for smart buildings was this year's group work topic. Smart building startup Ace With You was at the workshop and, over the next several months, will work with a group of eight students particularly interested in the topic.

MINA-NEWS: Two years ago, you mentioned the doubts certain engineering majors were having about their chosen field. Is this something you are still seeing?
Y. M.: Their awareness of sustainable development issues has only increased. What has changed is what they are doing about it. Instead of leaving the field altogether, they are seeking opportunities with companies that are making an impact. It is their number one priority. At the workshop, for example, they learned about what STMicroelectronics is doing to amplify its commitment to sustainability and do business compliantly amid increasingly strict laws and regulations.

MINA-NEWS: Is a one-day workshop a year enough?
Y. M.: Definitely not. We sent out a questionnaire to the attendees. We hope that their responses will help us evolve the workshop—maybe even switch to a new format. I would also like to get more students from other majors and faculty involved. ■

**Co-organized by Grenoble INP, GEM, IRT Nanoelec, STMicroelectronics, Ace With You, and Idex/UGA*

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Watch the 2022 Sustainable Electronics Workshop video: http://shorturl.at/cdC19

Embedded systems and IoT devices: What's new

Grenoble INP - Phelma, UGA is now the sole coordinator of the SEOC program on embed-ded systems and IoT devices, originally a joint program with Grenoble INP - Ensimag, UGA. This means that students who want to choose this major must enrol thorugh Phelma. The change will make things simpler in terms of administration but will not affect the curricu-lum.

For example, the large-scale software engineer-ing project completed by second-year students will still include teams of students from both Phelma and Ensimag.

This innovative program teaches students skills that are in high demand on the job market, from networks, systems-on-chip, and real-time and embedded computing to software, cloud computing, and AI. According to the CGE 2021 survey, with a career placement rate of 100%, graduates of the program have absolute-ly no trouble finding jobs.

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LIVE FROM MINATEC

Leti Innovation Days 2022: high-caliber, jam-packed content and networking

Leti Innovation Days 2022 will be held in-person after two years online. The now three-day event will take place on June 21, 22, and 23. Around 1,000 attendees are expected, and the program will include a plenary session, six workshops on selected tech topics, and an exhibition highlighting Grenoble's Silicon Valley, CEA-Leti's technology demonstrators, and SMEs from the region seeking international opportunities.

This year's event includes ample time—five hours a day—for networking starting at lunch and extending into the afternoon. Attendees can connect formally and informally through individual and small group meetings, personalized lab tours, and more.

Semiconductors and technological sovereignty are making global headlines and the EU is investing massively in the industry, creating a buoyant environment for this back-to-live event.

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Grenoble Green Capital seal for Midis MINATEC

In February, the Midis MINATEC lunch talks were granted the "Grenoble, European Green Capital" seal for sessions addressing environmental issues. The seal will help raise the profile of the already very popular Friday science lectures.

Three topics related to Grenoble Green Capital Month have already taken place or are scheduled. A talk on energy communities by two members of the Grenoble Green Capital and Transition scientific committee was held on March 4. The April 15 lecture will be about nature and biodiversity: François Parcy (CEA-Irig/LPCV) will talk about flowers and the mysteries of their origins. In May, the topic will be rethinking production and consumption.

www.minatec.org/midis
https://greengrenoble2022.eu

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GIANT to move to Y.SPOT Partners by summer

The Y.SPOT Partners building, which opened its doors on March 11 in Grenoble's Presqu'île neighborhood, will soon be home to the new GIANT Pavilion.

The immersive 45 sq. m space will be on the second level of the building, where its neigh-bors will include corporate tenants, labs, and startups. The pavilion will be used to welcome visitors, from international delegations to school groups and—through certain tours or-ganized by the Grenoble Alpes tourism board—the general public.

One of the pavilion's main features is an extra-large map of the Presqu'île neighborhood showing all of the main innovation stakehold-ers and the societal issues they are addressing. There's also a startup tree, plus videos, proto-types, and mockups of innovation projects. The ground floor's "Studio GIANT" will pro-vide information for school groups.

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BHT3, a distinctively urban building

MINATEC Entreprises is gearing up to unveil its plans for the BHT3 building. Construction on the more than 4,000 sq. m building will start this fall for delivery in early 2024. With four floors, it will offer 100% modular spaces that can be used for labs or offices, depending on tenants' needs. This mixed-use building right on rue Félix Esclangon will have a gener-ously sized landscaped terrace, large central atrium, and retail space on the ground floor.

The BHT model is a success, as confirmed by this latest expansion project. The spaces are flexible to adapt to startups' changing trajecto-ries—a hit with tenants. BHT1 is full and BHT2 reached full occupancy in 2021, two years ahead of schedule. The ground floor of BHT2 will also be overhauled to create an ad-ditional 200 sq. m of rental space.

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HORIZONS

Thingsat space internship for second-year engineering students

A second-year student at Grenoble INP - Phelma, UGA will be starting a truly stellar internship in May to work on two ground-based electronic scanning antennas for communication with Thingsat, a Cesug* space instrument launched into orbit on January 13 from Cape Canaveral.

Thingsat retrieves data from connected devices located in oceans, deserts, polar regions, and other remote areas far from traditional communications networks. It monitors climate, keeps an eye on sensitive ecosystems, and detects natural hazards.

Three other students majoring in integrated electronic systems completed internships in 2020 and 2021, prior to the Thingsat launch.

These internships give students a unique opportunity to learn about the space industry and add valuable experience to their résumés.

**Grenoble University Space Center*

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Silicon carbide: Soitec and CEA-Leti shift into high gear

Less than 30 months after Soitec and Applied Materials completed work on their silicon car-bide (SiC) pilot line at CEA-Leti's Substrate Innovation Center in late 2019, Soitec has an-nounced its plans to build a new factory to manufacture the substrate at scale.

The successful collaboration between CEA-Leti's researchers and Soitec's R&D teams is behind the record turnaround time. CEA-Leti was able to provide new insights into applying Soitec's SmartCutTM technology to SiC. Soitec's R&D teams leveraged each advance to stabilize and validate the process.

Together, they cut the usual development time in half.

The pilot line is now ready to produce SiC substrate samples for Soitec customers. The €220 million plant will ultimately employ 400 people.

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New Energy@School program for high school students

GIANT's Nano@School outreach program will be joined by Energy@School, starting in September 2022. This new program will heighten high school students' awareness of key concepts and issues around energy and provide them with information about the skills employers in the energy and related industries will be looking for in the future.

Students will spend a day at Green-ER doing two workshops developed by Grenoble INP - Ense3, UGA, G2ELab, and CEA-Liten scien-tists. They will explore three topics: electricity production and transformation, transmission and distribution, and storage.

Grenoble INP - Ense3, UGA students will talk to the high schoolers about their courses and school projects at lunchtime.

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Three Phelma students to sail to the Caribbean

Second- and third-year Grenoble INP - Phel-ma, UGA students Enola, Élia, and Carla will be embarking in October on a sailing adventure to the Caribbean for their gap year.

The trio set up a nonprofit called Trimousse in late 2021 to raise elementary school students' awareness of environmental issues and get kids in Grenoble and the Caribbean to ex-change viewpoints on the topic.

They plan to arrive in the Caribbean by the end of 2022 and will stay until the following May, visiting classrooms and running workshops using the "*Fresque du Climat*" game. They will sail back across the Atlantic before hurri-cane season, arriving in Grenoble for the be-ginning of the school year.

Keep up with the latest news at: https://trimousse.fr
Instagram : @trimousse_project
Facebook : TriMousse

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AGENDA

April 12
[Maison MINATEC]
GIANT ORIENTATION DAY
shorturl.at/nyIM8

April 15 [Maison MINATEC]
MIDI MINATEC WITH THE GRENOBLE, EUROPEAN GREEN CAPITAL SEAL
Topic: Flowers and the latest research on their mysterious origins
www.minatec.org/midis

May 9-1 [Grenoble]
PINT OF SCIENCE FESTIVAL
www.pintofscience.fr/events/grenoble

May 10 [Maison MINATEC]
SPINTEC'S 20TH ANNIVERSARY
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May 23 [Maison MINATEC]
AFFICHE TA SCIENCE !
Final day of the "La recherche fait école" school outreach program
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June 21, 22, and 23
[Maison MINATEC]
LETI INNOVATION DAYS
shorturl.at/ckATY

June 17 [Y.SPOT Partners]
START OF THE SUN TRIP ALPES
Solar-powered electric bike tour
www.thesuntrip.com/sun-trip-alpes-2022/

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