

MINA-NEWS

MINATEC
NEWSLETTER
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#71

New industrial chair to democratize infrared technology

The Deep Red industrial chair was created by Grenoble INP Foundation and IR detector manufacturer LYNRED to bring the power of infrared to everyday use cases. Three Gipsa-Lab research faculty are involved in the initiative, which will create opportunities for a number of engineering students.

Infrared imaging technology, once reserved for fields like space and defense, is now making inroads into use cases ranging from building energy audits and greenhouse gas monitoring to advanced driver assistance systems and industrial quality control.

One of the main challenges is how to make it easier for new, non-specialist users to interpret IR images characterized by significant noise and much lower contrast than conventional visible-light color images.

The new chair will investigate how to generate new images that borrow certain features from IR and others from color to emphasize the important information

THREE PHDS AND FOUR MASTERS PROJECTS OVER FIVE YEARS

The chair will also explore how to use artificial intelligence to automate the processing of IR images with features like noise reduction, object detection, and data fusion.

The five-year industrial research chair is affiliated with Gipsa-Lab, which will assign three of its scientists to projects, and with UGA engineering schools Grenoble INP - Ense³ and Grenoble - INP Phelma. Engineering school Polytech and psychology and neurocognition lab LPNC, also at UGA, will contribute to the chair.

LYNRED will allocate substantial resources to three PhDs and four Masters projects to support the researchers.

Learn more: <https://www.grenoble-inp.fr/en/research/deep-red-a-chair-supporting-infrared-sensors>

✉ jocelyn.chanussot@grenoble-inp.fr

INNOVATION

Nanomaterials: LMGP ramps up combinatorial deposition activity

LMGP, a recognized leader in spatial atomic layer deposition (SALD), is now using the technique for high-throughput combinatorial deposition.

This technique entails depositing thin films whose thicknesses and chemical concentrations can vary from one point to another, resulting in samples with a wider spectrum of properties. It can be used in photovoltaic and display technologies.

Specially designed 3D-printed deposition heads are used to distribute the properties of the layers deposited in specific ways.

This research is being conducted for the FastNano project, part of the Diademe project, whose purpose is to speed up the rollout of new sustainable high-performance materials.

✉ david.munoz-rojas@grenoble-inp.fr

Heart attacks could soon be diagnosed in under an hour

Saint-Étienne University Medical Center is gearing up to test a portable device for diagnosing heart attacks based on a technology developed by CEA-Leti and Irig.

This point-of-care test costs less than current techniques. However, it is also faster, a decisive advantage given that every minute counts when it comes to treating heart attacks.

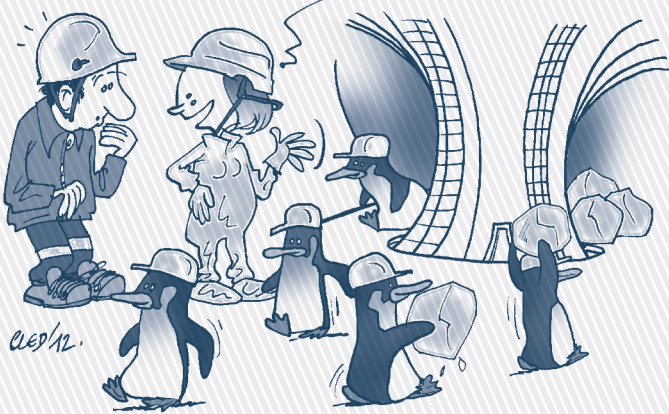
Aptamers, which are synthetic DNA strands with a unique 3D shape, are used instead of the animal antibodies of conventional diagnostic tests to capture troponin, a biomarker for myocardial infarction.

LAMP, a DNA amplification method similar to PCR, is then used on the sample. The aptamer-plus-LAMP protocol has been integrated onto a self-contained microfluidic cartridge simple enough to be handled by non-specialists.

Two patents have been filed to protect the technique.

✉ mathilde.aubret@cea.fr

AT LEAST THEY DON'T COMPLAIN ABOUT THE COLD.



Frozen pellets reach speeds of 3,600 kph on test bench for the ITER fusion reactor

In tokamak reactors, plasma instability is countered by injecting frozen gas pellets at high speed. The plasma temperature is rapidly decreased, mitigating disruptions and protecting the reactor walls and structure.

Pellet injection works well on conventional fusion reactors. But the ITER reactor uses higher-energy plasmas that require a different approach. Researchers at Irig have developed a 1:1 scale test bench to help address this challenge.

The Irig-designed test bench produces frozen pellets measuring 10 mm to 30 mm in diameter and strong enough to withstand high-speed injection—with acceleration of up to 1 km per second—into the reactor. The pellets also have to be produced in under 30 minutes to ensure that there are always enough on hand.

Experiments are currently being carried out to determine the exact parameters for ITER.

✉ francois.millet@cea.fr

ILL investigates little-understood high-temperature superconductivity

The mechanisms that underpin superconductivity at temperatures above 20 K are not fully understood. Researchers at Irig ran some experiments at ILL that could shed new light on a problem that has long confounded scientists.

They observed, at the atomic scale, an iron-nickel-arsenic pnictogen superconducting at 50 K. The images obtained showed iron atoms organized in a square planar lattice, with their magnetic moments pointing toward the center and vibration perpendicular to this square plane.

It is the interaction between the magnetic moments and the itinerant electrons in the material that cause the electrons to form bosons, called Cooper pairs, characteristic of superconductivity.

It is not yet known whether this mechanism is true for all iron-based superconductors or, potentially, for other materials as well.

✉ frederic.bourdarot@cea.fr

Microstructure of halogenated hybrid perovskites revealed

Halogenated hybrid perovskites, or HHPs, have garnered interest for their potential as photovoltaic materials. New insights into these materials' structural properties could shed new light on why their performance decreases so quickly over time.

Researchers at Irig studied MAPbI_3^* , a leading HHP. They discovered that the deformation that proves to be so detrimental to the thin films' stability could not be explained solely by the gap between their thermal expansion coefficient and that of the substrate.

Their research also revealed that the double crystalline orientation sometimes observed is due to the presence of ferroelastic twinned crystals.

Last, but not least, they showed that the nature of the first layer (MAI or PBI2) in contact with the substrate influences the orientation of the perovskite.

*methylammonium lead iodide

✉ stephanie.pouget@cea.fr

Project to help patients with spinal cord injuries walk again

Attendees at Leti Innovation Days in June had the opportunity to see a paraplegic patient walk with crutches. Beyond the wow factor, the video highlighted the encouraging results obtained by the CEA, EPFL*, and startup Onward since 2021.

The patient featured had been implanted with two devices: the Cimatec-developed Wimage brain activity recorder and a spinal-cord nerve-fiber stimulator.

The recently-started European Innovation Council project NEMO BMI will continue the research, using a new generation of self-adapting neuromorphic algorithms to perfect the processing of brain signals, and then integrating the algorithms on silicon components—a step that will make the technology easier to use by patients.

*Swiss Federal Institute of Technology Lausanne
<https://www.nemo-bmi.net>

✉ tetiana.aksenova@cea.fr / fabien.sauter@cea.fr

Room-temperature laser emission achieved in germanium-tin alloy

Scientists from Irig, CEA-Leti, and materials science lab C2N recently showed that a germanium-tin alloy microdisk laser cavity can emit at a record temperature of 32 °C. A tin content of 17% and a pedestal-type architecture that enables better dissipation of the heat from the stacked layers made the advance possible.

Tin atoms are larger than germanium atoms, so increasing the tin content to 17% should create crystal defects in the material. Here, the defects were prevented by a series of buffer layers with gradually increasing tin content used during epitaxial growth.

The advance marks a major step toward CMOS-compatible room-temperature laser sources.

Up next: improvements to push the device's operating temperature even higher and improve the alloy's crystalline quality.

✉ nicolas.pauc@cea.fr / vincent.calvo@cea.fr

MEMS micromirrors could help automotive LiDAR systems “see” further

CEA-Leti developed MEMS micromirrors for automotive LiDAR systems in research conducted for the EU Vizta project.

The CEA-Leti micromirrors move on two axes—right to left and top to bottom—, reflecting the laser beam to effectively scan a scene for vehicles, pedestrians, and obstacles.

The mirrors are controlled by piezoelectric actuators that slash operating voltage sixfold compared to current solutions.

And, instead of the usual gold or aluminum reflector, they used CMOS-compatible silicon Bragg layers, which are also less absorbent. This means that higher-powered lasers can be used, increasing the LiDAR’s range without overheating.

Finally, the mirrors also track their own movements to keep pedestrians’ eyes safe from the laser beam.

About Vizta: <https://www.vizta-ecsel.eu>

✉ laurent.mollard@cea.fr

Electronic nose could soon sniff out diseases

Irig’s electronic nose, originally designed for consumer and industrial applications, is now being used in the early detection of diseases.

Here’s how it works: some diseases—especially cancer—alter the metabolic production of volatile organic compounds (VOCs), some of which are relevant biomarkers.

In this research, which focused on two oeso-gastric cancer biomarkers, record detection limits (around one part per billion by volume) were reported.

Instead of a combination of peptides that self-assemble in a monolayer, here the sensitive element is a 3D nanostructure with a perfectly controlled morphology, obtained from a single peptide in solution.

The electronic nose is not a medical device, but it could be used in screening.

✉ yanxia.hou-broutin@cea.fr

Longer-range, more accurate RFID tag reading

RFID systems are inexpensive, but their range is limited, and they are not as accurate as they could be. This makes them unsuitable for tasks like automated inventory tracking with functionalities like people and property location or counting, for example.

CEA-Leti, a member of the Carnot Network, developed a miniaturized superdirectional antenna and direction and distance estimation algorithms in research conducted for two projects*.

The demonstrator produced by CEA-Leti performs a 360° beam scan, determining the direction of a tag to within a few degrees’ accuracy. For distance, the goal is to accurately locate tags to within ten centimeters. The antenna measures just 18 cm in diameter, almost half its wavelength.

Livestock monitoring field tests (on ewe and lamb herds) will be carried out with fellow Carnot Network member *France Futur Élevage* in 2023.

The researchers hope that they will then be able to integrate their technology into industrial logistics solutions.

**Lotar (Auvergne Rhône Alpes regional government) and, later, Salto (an inter-Carnot project)*

✉ jacques.reverdy@cea.fr

3D integration: chip-to-wafer bonding alignment 10x more accurate

An innovative magnetic sensor to help align chip-to-wafer bonds for 3D integrated circuits was recently developed and patented by a team of scientists at Irig.

When used in optimal conditions, the sensor is accurate to within 50 nm: ten times better than the 500 nm today’s optical solutions can achieve. The improvement could help substantially increase the interconnect densities in the stacks that make up 3D ICs.

A PhD candidate co-supervised with two other institutions* contributed to the development of this new sensor, which is made up of a magnetic reference layer and a two-state (parallel/antiparallel) readout layer. It is most accurate when the elements being bonded are less than one micron apart.

The research was part of an ERC Proof of Concept project called Magalign.

**University of Strasbourg, France and FHNW University of Applied Sciences and Arts Northwestern Switzerland*

✉ ricardo.sousa@cea.fr

More reliable urban CO₂ mapping

CEA-Leti designed a secure circuit board to provide near-sensor data processing. The boards, made up of microcontrollers and hardware security chips, will be tested on CO₂ sensors in major cities in 2023.

Once the data gathered by the sensors is processed, it will be sent to a blockchain to ensure full traceability, and then saved to a database.

The sensor testing campaign is part of the European Icos project, whose objective is to map CO₂ emissions on an international scale. CEA-Leti is helping develop a secure solution capable of delivering reliable measurements.

The circuit boards being tested here were developed together with CEA-List as part of the Green Blockchain moonshot project.

In related news, several other security solutions are being investigated in IRT Nanoelec projects.

✉ christine.hennebert@cea.fr

DAY BY DAY

Biomimetic adhesive expert joins LMGP

Charlotte Vendrely, formerly of Cergy-Pontoise University, has joined the faculty of Grenoble INP-Phelma, UGA. She had just completed a one-year placement in Grenoble while still at her former institution, and will now teach classes in the biomedical engineering program and conduct research at LMGP.

A biomimetic adhesive specialist, Vendrely has been coordinating the BioAd project, backed by the French National Research Agency (ANR), since the beginning of this year.

The project is setting its sights on innovative, biocompatible, petrochemical-free, non-toxic adhesives that could be used as a faster-healing alternative to traditional post-surgical sutures, for example. The adhesives, based on proteins that self-assemble in patterns, are inspired by the “glue” shellfish produce to stick to surfaces.

✉ charlotte.vendrely@grenoble-inp.fr

MICHEL IDA, CEA Tech

“We have to measure the societal impacts of our research.”

MINA-NEWS: You have been leading CEA-Tech’s efforts to assess the societal impacts of its research since 2021. What are the program’s objectives?

Michel Ida: The first, and most important, is to make sure our project, program, and partnership strategies incorporate these concerns, something we have already begun to do with ecodesign. Our research has a powerful impact on our lives, on our cognitive systems, and on our ability to function as a society. We must learn to embrace this complexity and engage in meaningful debate so that we can learn from it. The work we are doing here also has to make its way into our organizational culture and our communications.

How is your work organized?

M. I.: We have a community of 200 CEA employee volunteers and a circle of 30 outside members that includes experts in philosophy, religion, anthropology, psychology, and other fields. Every year we run four or five meetings on specific topics and, starting in 2022, we will be running two major events per year. Our event on the impact of virtual/real superimposition on April 7 was attended by 600 people.

Do you have plans to expand the community?

M. I.: Research institutes on the GIANT campus can join, and we do interact with similar initiatives, not only in France, but internationally as well. Given everything that is going on, it is urgent that we look at our impacts on society. The number of science deniers is growing, fake news is all over social media, and up and coming scientists are seeking meaning in what they do. ■

✉ michel.ida@cea.fr

Our next major event will take place on November 22 and will address:

- The quest for strategic autonomy and sovereignty in digital technology, energy, and health: Looking at societal impacts.
- The societal impacts of environmentally respectful climate-change-adapted communities.

DAY BY DAY

CEA-Irig welcomes new director Pascale Bayle-Guillemaud

Pascale Bayle-Guillemaud succeeded Jérôme Garin as director of Irig, the Interdisciplinary Research Institute of Grenoble, on August 1. She had previously served as Irig’s deputy director since its inception in 2019.

A physicist with expertise in materials characterization using electron microscopy in particular, Bayle-Guillemaud would like to raise this basic research institute’s profile.

Now that construction has been completed, Bayle-Guillemaud would like to promote Irig and ramp up its involvement in the French government’s PEPR research programs, which intersect with Irig’s activities in fields like health, energy, spintronics, materials, agroecology, and quantum.

✉ pascale.bayle-guillemaud@cea.fr

Fundraising: CEA-Leti startups bring in €25 million

Grenoble-based Scintil Photonics and elichens, both startups developing CEA-Leti technologies, raised €25 million in capital over the summer.

Scintil Photonics raised €15 million in two separate fundraising rounds in June and September. The company’s silicon photonic integrated circuits push server-to-server data transmission speeds over the terabit-per-second mark in data centers, cloud computing, and telecommunications. The influx of capital will support expansion in Asia-Pacific and the Americas. Scintil Photonics has an office in Toronto.

Meanwhile, Japan-based NCE acquired a \$10 million stake in elichens. The companies both address the air quality monitoring market.

NCE will integrate elichens sensors into its products and sell an elichens indoor air monitoring unit.

✉ marion.levy@cea.fr

Back to school at Grenoble INP - Phelma, UGA

The 2022-23 school year is underway at Grenoble INP - Phelma, UGA, with an incoming cohort similar to last year’s.

On September 2, first-year students arrived on campus: 370 in the traditional engineering program and 26 in the internship-based program in microelectronics and telecommunications. A majority—77%—came from general prep programs, 12% from the INP prep program, and 8% on application.

Female students represent 30% of the cohort, just like the previous year.

While the numbers are similar, this year is different in spirit. The school has set the tone for a more responsible, respectful start to the academic year. The administration is eschewing the traditional “initiation” activities in favor of orienting new students to campus life. Student groups are also on board to make sure partying doesn’t get out of hand.

✉ alexis.sableaux@grenoble-inp.fr

Grenoble INP - Phelma, UGA wins award for innovation in teaching

The IPhy (physics for photonics and microelectronics) program at Grenoble INP - Phelma, UGA won a jury’s favorite award from the CGE, a consortium of competitive higher education institutions in France, for its challenge-based curriculum.

So, what are the challenges, exactly? A series of cross-disciplinary tasks students must complete as they work on a project about a physical or optical phenomenon. The goal? To give students increasing responsibilities and teach them to work independently.

This year, a group of students set up an optical bench and automated data acquisition system to study the Zeeman effect in quantum physics.

The teaching team assists the third-year students who, in turn, assist the second-year students, who teach a simplified version of the project to first-year students.

✉ celine.ternon@grenoble-inp.fr

MINATEC startups win big at i-Lab 2022

The 2022 edition of the i-Lab innovation competition was a particularly good one for the MINATEC campus, which brought home one of three grand prizes and awards for three other startups.

CEA-Leti won three awards: a grand prize for Qosmos, which is developing a million-plus qubit quantum computer, as well as awards for Admir and its simplified infrared spectrometry method for tissue pathology testing, and BAIO DX, with its innovative microbiological diagnostic solution.

Grenoble INP also did well, bringing home an award for Cilkoa, which is leveraging research at LGP2 and Simap to produce cardboard with the same barrier characteristics as plastic.

Orioma, which works with CEA-Leti, also won a grand prize for its low-power cameras.

Finally, Safehear, a smart earplug company co-founded by a recent Grenoble INP - Phelma, UGA graduate, also won an award.

✉ sylvain.colomb@cea.fr

LIVE FROM MINATEC

Experimenta 2022, ten days of the arts and sciences

The *Biennale Arts Sciences* will be held on October 12 to 22, offering up its usual exciting program covering a broader scope than ever.

MINATEC and Y.SPOT Partners will host events, of course. This year, however, new locations throughout the Greater Grenoble, Voiron, and Grésivaudan Valley areas have been added.

The Experimenta exhibition held during the *Biennale* features a forum, art installations, performance art, and around 20 concerts and shows for all ages. It is free of charge.

The themes of the 2022 *Biennale* are our relationship to living organisms and the transformations induced by digital technology.

New this year: an art show at the top of the Bastille fort in Grenoble with works that interrogate the relationship between man and nature and a monumental light installation on the central quad of the Grenoble-Alpes University campus in St. Martin d'Hères.

www.experimenta.fr

✉ laurence.bardini@theatre-hexagone.eu

Érasmia Dupenloup appointed CEO of Minalogic cluster

Érasmia Dupenloup succeeded Jean-Éric Michallet as CEO of the Minalogic cluster this summer.

A Grenoble INP alumnae and computer scientist, Dupenloup's career has spanned research and private-sector business and taken her from France to the United States and back again.

She joined Minalogic in 2012 to head the cluster's business development activities for its member companies.

Government funding for tech and industrial development projects is up at both the French and European levels, and Minalogic's home base, the Auvergne Rhône Alpes region, has already carved out a top position in Europe's electronic component, artificial intelligence, cybersecurity, quantum, and Industry 4.0 sectors.

Dupenloup will leverage these favorable tailwinds to make Minalogic a "factory of factories" that will help startups and deeptech companies establish long lasting production facilities in the region.

✉ erasmia.dupenloup@minalogic.com

HORIZONS

Consumers to test "Jules Verne" augmented reality glasses

The glasses, which reinterpret the audioguide concept, were developed by theater company *La Fabrique des petites utopies* during its residency at the Atelier Arts Sciences.

The CEA and local startups MicroOled, Akylas, and ActivMotion helped develop the prototypes to be made available for testing by the public at Experimenta.

Visitors at the exhibition will be able to try the glasses on site and during tours of downtown Grenoble—augmented with audio and visual content—that will start at the tourist office. Feedback from the tests will help the developers improve the product and get it ready for commercialization.

Grenoble's tourism bureau will be among the early adopters, and the theater company is also working with the City of Chambéry and artificial intelligence research institute MIAI Grenoble Alpes, also interested in the glasses.

✉ nathaly.briere@cea.fr

Altrans Énergies goes to Washington

Altrans Énergies, a Grenoble startup that specializes in power distribution and equipment monitoring solutions, is one of fifteen winners selected for the New Technology Venture Accelerator, an initiative of the Office for Science and Technology of the French Embassy in the United States.

The startup, which already has a dozen pilot projects running in France and China, will receive assistance with business and technology partnership development in and around Washington, D.C.

Founded in 2020, Altrans Énergies utilizes a technology developed over ten years of research at Gipsa-Lab. The company's solution, built on specially designed sensors and electronics, detects the early warning signs of a fault and can be used while the power is on. It is accurate to within several meters and costs 20 times less than competing solutions.

✉ cornel.ioana@altransinnov.com

QuantAlps: orchestrating quantum research in Grenoble

Grenoble's leadership in quantum research is undisputed. And a more coordinated quantum community could help push local advances in the technology even further.

CNRS, the CEA, Inria, and UGA recently created an interdisciplinary research federation called QuantAlpes to orchestrate quantum research in Grenoble. QuantAlpes will support startup creation, incubate new ideas, coordinate academic degree programs, secure more PhD funding, and raise Grenoble's profile internationally as a center for quantum.

The social sciences and humanities will also play a role, as QuantAlpes will investigate ethics and acceptability issues around quantum.

The federation's activities will take the form of five major multi-partner research projects, one of which will be led by Irig and another by CEA-Leti.

✉ pierre.chirsen@univ-grenoble-alpes.fr

Gaëlle Del Rey wins women in technology research award

Gaëlle Del Rey of CEA-Leti won one of three IRT Nanoelec awards for outstanding women in technology research. A member of CEA-Leti's finance department, Del Rey is also responsible for the financial management of IRT Nanoelec programs.

She won the award for her work at IRT Nanoelec, which includes recording and consolidating the financial support, machine time, and man-hours contributed by the institute's 20 partners and making sure each item on the books is properly documented.

Her role is particularly important in terms of facilitating resource sharing and creating trust in an "institute without walls" like IRT Nanoelec.

Del Rey will officially receive her award at the IRT Nanoelec annual general meeting in December.

The two other awards will go to women from UGA and STMicroelectronics.

Learn more about the three winners:

<https://irtnanoelec.fr/laureates-des-prix-nanoelec-pour-les-femmes-dans-la-recherche-technologique/>

<https://irtnanoelec.fr/actualites/award-for-women-in-technological-research/>

✉ francois.legrand@cea.fr

Engineering students assess their school's carbon impact

A group of three third-year students in the transition engineering program at Grenoble INP - Phelma, UGA completed a greenhouse gas emissions audit of their school for the year 2019.

The lack of integrated data, especially concerning building construction and maintenance, did not stop the students from doing a very thorough job.

According to the audit, the school generates one ton of CO₂ equivalent per student per year, similar to fellow Grenoble INP school Ense³, which also completed an audit.

The students were also able to identify the main culprits behind the school's GHG emissions: travel abroad, heating, food services, and electricity.

The audit will be updated by another group of students this year. All sources of emissions will be included so that the school can identify areas for improvement.

✉ raphael.boichot@grenoble-inp.fr

AGENDA

October 4 to 8 [MINATEC]
PARVIS DES SCIENCES 2022
SCIENCE FAIR
parvis-des-sciences.com

October 6
[Grenoble INP – Phelma, UGA]
DEEP RED INDUSTRIAL CHAIR
INAUGURATION
murielle.brachotte@fondation.grenoble-inp.fr

October 9 [Grenoble]
GRENOBLE EKIDEN RELAY
MARATHON
www.grenoble-ekiden.fr

October 12 to 22
[Greater Grenoble area]
EXPERIMENTA ARTS AND
SCIENCES EXHIBITION
www.experimenta.fr

October 18 [Tokyo]
LETI INNOVATION DAYS
Could innovations in semiconductors trigger the Metaverse revolution?
urlz.fr/jirC

October 20 [Phelma]
CORPORATE PARTNERS DAY
aurelie.dinola@grenoble-inp.fr

October 20–22
[MINATEC and Y.SPOT]
EXHIBITION, FORUM,
AND PROFESSIONALS-ONLY DAY
OF THE BIENNALE ARTS
SCIENCES 2022
urlz.fr/jirJ

November 18 [Phelma]
CLASS OF 2021
COMMENCEMENT
alexis.sableaux@grenoble-inp.fr

November 21 and 22 [Grenoble]
IN MRAM 2022
INTRODUCTORY COURSE
ON MRAM MEMORIES
www.inmram.com

November 22
MAJOR EVENT ON THE SOCIETAL
IMPACTS OF TECHNOLOGY
RESEARCH
Topics: the quest for strategic autonomy and sovereignty, life in environmentally respectful climate-change-adapted communities
michel.ida@cea.fr

CONTACTS



MINA-NEWS is published by MINATEC 3, parvis Louis-Néel – 38054 Grenoble cedex 9, France

Head of Publication: Jean-Charles Guibert - **Editor-in-Chief:** Julie Spinelli

Contributors: Marion Levy, CEA-Leti, marion.levy@cea.fr

Nathalie Mathieu, Phelma, FMNT, nathalie.mathieu@phelma.grenoble-inp.fr

Patrick Warin, IRIG patrick.warin@cea.fr, Julie Spinelli, MINATEC, julie.spinelli@cea.fr

Alexis Sableaux, Grenoble INP – Phelma UGA alexis.sableaux@phelma.grenoble-inp.fr

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