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Organs-on-chip could give diabetes patients new hope

Researchers from Irig and CEA-Leti successfully maintained pancreatic cells called islets of Langerhans in culture on a microfluidic chip for a month and were able to measure individual islets' insulin production. This breakthrough could improve the efficacy of islet transplants, a treatment given to some diabetes patients.

Islets of Langherans are sphere-shaped pancreatic cells between 200 microns and 300 microns in diameter. Although they account for just 3% of the pancreas, they perform the vital function of releasing either insulin or glucagon to keep blood glucose levels in check.Diabetes occurs when these cells no longer function optimally or cease to function altogether. France's medical regulator approved islet transplants in 2021 for patients with severe diabetes.

SELECTING THE MOST PROMISING ISLETS BEFORE THE TRANSPLANT

The joint Irig-CEA-Leti research team built a special microfluidic chip and "grew" the islets of Langherans in it, keeping the cells alive for a month.

This alone represents a significant challenge. However, the researchers went even further, instrumenting the chip and measuring each islet's insulin production in response to varying glucose levels.

The system works, which means that it could be used to identify the best performing islets and study the molecular mechanisms at work inside them.

Currently, as there is no way to predict islet behavior, cells are taken from four or five donors per patient to increase the chances of a successful transplant. This advance could help improve the efficacy of islet transplants by providing insights into which islets will work best.

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INNOVATION

Smaller reversible fuel cells could be more powerful

Miniaturizing reversible fuel cells could be the best path toward higher power densities. The Adfun project, a joint effort between LMGP and Imperial College London, is testing this hypothesis through two PhD research projects, one on new materials and one on advanced electrochemical interface characterization.

LMGP will focus on an unconventional cathode material, lanthanum nickelate, which will be deposited in thin (tens to hundreds of nanometers) layers and microstructured to increase the active surface area.

The objective of the Adfun project is to develop thin (under a micron thick) reversible fuel cells that can operate at 500 °C instead of 800 °C and whose specific power density is five times that of conventional fuel cells..

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Electric vehicles fill up with GaN

A joint lab formed by CEA-Leti and CEA-Liten has signed several R&D contracts for power conversion projects with manufacturers from the automotive industry since the EU H2020 Moduled project, which was completed a year ago.

The 100 kW version of the lab's Moduled gallium nitride (GaN) inverter offers four times lower losses, 50% higher frequency, and a 20% smaller form factor than its silicon counterpart.

With these characteristics, the inverter would be a good match for electric vehicles slightly more powerful that the Renault Zoé—so the market is huge.

The joint lab also made a 3D digital twin of the inverter that can be used to develop the architecture and design and identify any technology-related issues that need to be addressed during development. It should help shorten project lifecycles.

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PreCoM project: powerful sensors for predictive maintenance

CEA-Leti developed some truly exceptional wireless vibration and temperature sensors for the EU H2020 PreCoM project on decision support for predictive maintenance.

The sensors were tested on ten-meter-high machine tools used to manufacture wind-turbine hubs.

With power consumption of just 10 µwatts in sleep mode and 10 mW to 15 mW when awake, the sensors are extremely efficient, with a battery life of one year.

They take measurements at high frequencies (10 kHz) and offer a range of 50 meters, even in metal-containing environments.

The matchbox-sized devices can be positioned very close to the milling heads, gears, or bearings, where they can detect early warning signs of excessive wear or damage.

Future improvements could include embedded AI or an energy harvesting system.

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Nickel almost as good as platinum for fuel cells

Fuel cells with platinum electrodes are efficient but, because of the material's scarcity and high cost, are not a viable long-term option.

Nickel, much more readily available, could be used as a catalyst, but only if its efficiency can be improved drastically.

A team of researchers from Irig and CEA-Liten developed an electrode with a nickel catalyst grafted on a gas diffusion layer modified with carbon nanotubes that performed well, delivering a current density of 0.4 A/cm^2, not too far behind platinum's 1 A/cm^2.

Here's how they did it. Based on insights gained from several advanced characterization techniques used simultaneously, they improved surface concentration of the catalyst and, crucially, active layer hydration.

Up next: integration of the electrode into a fuel cell.

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Memristors find new use in neural networks

Memristors are used as memory. But what if they could also be used as the basic building blocks of spiking neural networks? LMGP and TIMA will be investigating this new use for memristors during a two-year MITI 80 PRIME project that is just getting started.

They will be looking at a new memristor material, lanthanum nickelate (La_2NiO_4), that should enable multiple stable resistive states during a machine learning process and be able to hold on to the values acquired.

This kind of non-volatile interconnectable artificial synapse could be used to build networks of tens of thousands of synapses.

The scope of the research covers the material, the memristor device, the circuit architecture, and the machine learning algorithm.

A microfabrication technology will also be developed for a 16-memristor SNN.

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World's first 2D ferromagnetic materials at 229 K

Researchers at Irig achieved a world first when they grew Fe_5GeTe_2 thin films on sapphire using molecular-beam epitaxy.

They were able to obtain a single-crystal two-dimensional material with controlled composition. Here, the simple bilayer boasts ferromagnetic ordering at temperatures up to 229 K, compared to under 100 K for most 2D magnets made using mechanical exfoliation.

France's national SOLEIL Synchrotron and other advanced characterization resources were used to study the new material's standout properties.

The researchers are pursuing new advances toward ambient-temperature permanent magnets, with several alloys and dopants currently under evaluation.

Two-dimensional magnets with controlled structures like these could support the development of ultra-compact spintronic devices that can be activated by light or by an electric field.

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New material for faster microlasers: the Crumble project

The Crumble project, financed by France's national research agency (ANR), is setting its sights on shorter-pulsed (500 picoseconds instead of 700) and, therefore, more powerful lasers for telecommunications and micromarking.

IMEP-LaHC is coordinating the project, which involves two other labs* and long-time IMEP-LaHC partner Teem Photonics.

The partners will be developing a new material—chromium-atom doped yttrium-aluminum oxide nanocrystals in a sol-gel matrix—with specific properties for the saturable absorber and active laser medium.

IMEP-LaHC will use this material to fabricate integrated optics on glass substrates.

New waveguides will need to be designed, and the fabrication processes will have to be adapted significantly.

**Laboratoire Hubert-Curien at Jean Monnet University in Saint-Étienne and ICCF at Clermont-Ferrand University*

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Medical radiology expands into point-of-care imaging

Radiological diagnostics, which include X-ray and other imaging techniques, can be a challenge if a patient cannot be transported or is located far from a medical imaging facility.

A Thales-led project involving CEA-Leti to develop mobile point-of-care radiology solutions recently obtained French government funding*.

The project consortium is investigating a lightweight, ergonomic X-ray machine and a mobile 3D scanner leveraging miniaturized X-ray sources and digital service platforms.

CEA-Leti is working on two aspects. The first is simulating the imaging chain (source, detector, and 3D image reconstruction algorithms) to dimension the target system.

The second is producing the material that will enable highly compact and portable X-ray sources: silicon substrates that carbon nanotubes will be grown on under vacuum.

**PSPC grant for industry-building projects coordinated by French clusters*

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Photovoltaics: yield-boosting solar inverter

CEA-Leti and CEA-Liten are joining forces to develop a low-loss inverter to boost photovoltaic solar panel conversion efficiency. Inverters transform the direct current PV panel output into alternating current compatible with domestic electricity networks.

The new inverter is built on 100V and 650V GaN on silicon power transistors. It is faster (150 kHz) and cuts losses by 40% (3% instead of 5%) compared to silicon components. Plus, the transistors can withstand higher temperatures (200 °C instead of 150 °C).

For rooftop installations, the inverter is compact enough to be integrated into every panel. It will primarily address the domestic-self consumption market.

A demonstrator will be presented at the upcoming Leti Innovation Days on June 21, 22, and 23.

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The magnetic superconducting mysteries of heavy-fermion metal UTe_2

UTe_2, which confounds a 60-year-old theory of superconductivity, has captured the scientific community's attention ever since it was discovered in 2018.

Researchers at Irig have now determined that a much stronger than normal magnetic field is required to destroy UTe_2's superconductivity.

Even more surprising is that the material's superconductivity actually gets stronger under magnetic fields between 15 tesla and 35 tesla—ten to a hundred times stronger than what conventional materials can withstand.

And, under a magnetic field between 45 tesla and 60 tesla, a new superconducting state is observed.

A "spin-triplet" state could explain this particularly robust superconductivity.

Neutron scattering experiments at ILL point to magnetic fluctuations as playing a role in UTe_2's unusual behavior.

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Microtechnology could aid in the study of tau protein's role in Alzheimer's

Tau protein plays a role in the onset and progression of Alzheimer's disease—that much scientists are sure about.

But, due to a lack of tools for manipulating and studying the protein, its exact role is not known.

CEA-Leti in Grenoble and ICM* in Paris recently won an Alztec Innovation Program grant to solve this problem.

The researchers in Grenoble will develop a microfluidic circuit to isolate individual cells that contain the tau protein by encapsulating them in micro-droplets of an aqueous solution.

The flow, speed, and pressure inside the circuit will be tightly controlled.

They will also develop a system to distribute the encapsulated cells in 96-well cell culture plates so that dual RNA amplification and screening for the tau protein involved in Alzheimer's can be performed.

**ICM is a center for brain and spinal cord research*

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DAY BY DAY

The Grenoble branch of nonprofit *Cheer up!* gets back to work

More than 200 runners entered the *Race Against Cancer* organized by *Cheer Up!* on April 10. The Grenoble INP - Phelma, UGA student nonprofit helps people between the ages of 12 and 25 living with cancer.

The race raised more than €3,000, marking the nonprofit's post-pandemic comeback.

The funds will be donated to Institut Curie and Fondation de France.

Cheer Up! student volunteers are working hard to get their hospital visits back up and running now that Covid-related restrictions are easing.

At the national level, *Cheer Up!* provides training, which is required before volunteers can visit with patients. This has also been on hold since 2020, so it is at the top of the Grenoble branch's agenda.

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Antennas can be printed on 3D objects with plastronics

The six-year MINT Chair on plastronics recently wrapped up its research. IMEP-LaHC, LG2P, and the S-mart Grenoble Alpes CIM platform will continue to evaluate the potential and performance of the RF antennas developed.

What makes these antennas unique is that they are printed directly onto different-shaped 3D objects using jetting* print heads mounted on six-axis robots. This new process could be a more efficient alternative than bonding RF or RFID tags.

The research funded by the MINT Chair led to the qualification of the conductive inks used, validation of their adherence to the substrates, and verification that the distance between print head and part is sufficient to handle different sized objects.

A PhD dissertation on the printed antennas' performance is slated for completion this year.

**A printing technique that deposits inks of varying viscosities*

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JÉRÔME GARIN
Director, Irig:

"Our junior scientists are nothing if not passionate about their work."

MINA-NEWS: You have been at the CEA for 37 years and plan to retire in September. What is your main takeaway?
Jérôme Garin: I am really pleased to see that our younger scientists are just as passionate about their work as we were about ours back in the 80s. You can just see it, especially at events like PhD student orientation. We did miss out on several of those occasions during the pandemic, but the memories of past ones are dear to me.

MINA-NEWS: In terms of science, what has made the greatest impression on you?
J. G.: Without a doubt, advances in instrumentation and data analysis. When I was young, you could write an entire dissertation on the sequencing of a single gene. Today, an entire human genome can be sequenced in eight hours. Without this kind of progress, we never would have been able to develop a SARS-CoV-2 vaccine in under a year.

The development of large research infrastructures at the national level has also been a game changer in biology and health, by providing access to shared state-of-the-art equipment. Irig is involved in three of these infrastructures*. This is nice in terms of recognition for our labs, of course. But it is also a great opportunity.

MINA-NEWS: Is there anything you regret?
J. G.: Not so much a regret as an observation. We have moved away from annual funding for basic scientific research and toward project-based funding. It hasn't always been easy to adapt to this change, but we have. What people who work in research want is to be able to devote most of their time to doing experiments and supervising bright young minds.■

**Frisbi, ChemBioFrance, and ProFI*

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CEA-Leti partnership with UCLouvain off to a great start

CEA-Leti and Université Catholique de Louvain (UCLouvain) in Belgium signed a three-year partnership agreement in early 2022 that has already sparked two workshops.

A kickoff workshop was held at UCLouvain in March, and a second workshop, which included CEA-Leti lab tours, took place in Grenoble in late May.

UCLouvain (not to be confused with nearby IMEC) is home to 21 research institutes and 3,000 researchers, making it a major research center. One of its institutes, ICTEAM*, also recently signed a partnership agreement with CEA-Leti.

The partnership will support advances in micro and nanotechnology, telecommunications, biotechnology, sensors, and RF and mmW circuits—research areas shared by both UCLouvain and CEA-Leti.

The partners are also joining forces around the eco-innovation of electronic devices and circuits for more sustainable electronics.

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Y.SPOT PARTNERS welcomes two artists-in-residence

Atelier Arts Sciences, which moved into Y.SPOT in March, is currently hosting two artists-in-residence whose work will be shown at the next Biennale Arts Sciences in October.

A theater company (*La Fabrique des petites utopies*) is exploring a reinterpretation of the audio guide concept through a project called *Lunettes Junes Verne* (Jules Verne Glasses).

The immersive glasses will give tourists a virtual experience as they move through cities and other sites of interest in the real world.

In parallel, circus artist Rachel Martin is working on a project called *Kinesphere 8.0*.

She will perform inside a 20-sided polyhedron instrumented with sensors, the Kinesphere, in an exploration of movement and of the traces the dancer's body in motion leaves behind. The idea is to capture motion in writing, much like a musical score captures a song.

www.atelier-arts-sciences.eu

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Émile Rivoire ready for 2,500 km of solar-powered cycling

Émile Rivoire of Phelma's Class of 2016 is ready for Sun Trip Alpes 2022, a 2,500-km solar-powered cycling adventure. He recently picked up his two CEA-built solar modules which, he hopes, will get him all the way to the finish line without plugging in to the grid.

A team at CEA was tasked with building the 2.3 kilogram, 0.8m^2 modules from commercial SunPower cells on an aluminum honeycomb substrate for structural support.

A 750 Wh lithium-ion battery can be fully charged in two hours of full sunlight, for a range of 80 km to 120 km. Each of the two modules has five power lines so that they can continue to provide a partial power supply even if some of the cells get damaged.

The fully equipped and packed solar bike will weigh in at more than 30 kilograms, but that doesn't scare Émile, who only plans to use the electric assist as just that—an assist.

Don't miss a special pre-tour event on June 16 at Maison MINATEC where the riders will present their solar-powered bikes.
www.thesuntrip.com/sun-trip-alpes-2022

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LIVE FROM MINATEC

Leti Innovation Days to put a spotlight on eight semiconductor leaders

Leti Innovation Days is a much-anticipated event for electronics-industry stakeholders.

The past year has been unprecedented, whether it was the component shortage or the dizzying pace of progress on a number of technologies.

On June 21 to 23, industry leaders will come together to talk about their company's tech and strategy choices and, of course, network. Eight top semiconductor-industry executives will be in Grenoble for the event:

Robert Chau (Intel), Ted Letavic (Global Foundries), Sundar Ramamurthy (Applied Materials), and Ravi Subramanian (Siemens) will be coming from the US, while Grenoble's ecosystem will be represented by Pierre Barnabé (Soitec), Olivier Blum (Schneider Electric), Jean-Marc Chéry (STMicroelectronics), and, finally, Sébastien Dauvé, CEO of CEA-Leti.

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MINATEC to host European IndTech 2022 conference

As current holder of the Presidency of the Council of the European Union, France is hosting the biennial Conference on Industrial Technologies, IndTech 2022. CEA Grenoble is organizing the event at MINATEC from June 27 to 29.

This year's event will focus on tomorrow's industrial technologies and is expected to bring in major stakeholders from Europe and around the globe.

Research organizations, industrial corporations, startups, financers, and policymakers will come together around topics like the environmental and digital transitions.

And the program is impressive, with more than 70 speakers, including from the CEA and Grenoble INP. Topics will include success stories that show sustainability and economic competitiveness can go hand in hand.

IndTech 2022 will also provide a first look at the results of the Horizon Europe calls for projects, and an opportunity to talk about what is ahead for 2023–2024.

indtech2022.eu

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HORIZONS

FD-SOI leaders form next-generation alliance

CEA-Leti, Soitec, STMicroelectronics, and GlobalFoundries have formed an alliance on FD-SOI, a technology born 20 years ago at CEA-Leti.

They will work together to develop a next-generation semiconductor for connected vehicles, IoT, Industry 4.0, and 5G and 6G telecommunications.

STMicroelectronics currently volume-manufactures FD-SOI circuits at the 28 nm node. The goal is to move to the 10 nm node.

The alliance is in part a response to the semiconductor shortage. However, it is also a path toward higher performance.

FD-SOI transistors are 25% faster than bulk silicon transistors and require 40% less power. The next generation of semiconductor will capitalize on these advantages.

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Grenoble engineering students volunteer in Togo

This summer, a group of thirteen Grenoble engineering students will go to Gamé Kové, a village 70 km north of Togo's capital, Lomé. This is the program's fourth consecutive year.

Nonprofit group Solida'Rire is coordinating the month-long mission, which includes five first-year Grenoble INP - Phelma, UGA students. A first group of seven students will depart in mid-June, and a second group of eight will take over in mid-July.

This summer the plan is to build a new building for the community's school, and have the structural work and roof done in time so the building can be used at the start of the next school year. A new team will return the following summer to finish the inside.

While they are there, the volunteers will also teach some math and French to the local children.

Funds are being raised here: http://tiny.cc/04qruz

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Getinge of Sweden acquires Fluoptics

Fluoptics, founded in 2009 to develop and commercialize a technology based on CEA-Leti patents, is the only European company active on the fluorescence-imaging-assisted surgery market. It does business in 20 countries.

In late April, Fluoptics announced that it would be bought out for €26 million in cash on closing by Getinge, one of the world's leading operating table and lighting suppliers.

The two companies had previously—more than a decade ago—completed a one-off R&D project together. They will now develop synergies around Getinge's new center for excellence in optics and vision in Orléans, France.

Fluoptics and its 30 employees will remain in Grenoble so that they can maintain ties with their innovation ecosystem, which includes pursuing a relationship with historic partner CEA.

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Grenoble to host 2022 EuCNC & 6G summit

The European Commission has tasked CEA-Leti with organizing the 31st European Conference on Networks and Communications & 6G summit, an event for major telecommunications stakeholders.

From research organizations to operators and manufacturers like Orange, Nokia, Huawei, Ericsson, Intel, and Soitec, more than 500 attendees are expected at Grenoble's World Trade Center from June 7 to 10.

Telecommunications expert Michel Combes* will deliver the keynote.

The summit will address telecommunications from a variety of angles, with topics like 5G and mobile IoT rollout, 6G research and development, and the most promising systems for 2030. These are all major topics for Grenoble's innovation ecosystem, especially CEA-Leti.

An expo will feature 70 booths showcasing the latest technologies developed through multi-partner EU-funded projects and other initiatives.

**Former executive at Alcatel-Lucent, Vodafone Europe, and Sprint.*

www.eucnc.eu

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AGENDA

June 7–10 [World Trade Center]
31ST EUROPEAN CONFERENCE ON NETWORKS AND COMMUNICATIONS & 6G
www.eucnc.eu

June 9 [Online]
WEBINAR ON "SCIENCE, TECHNOLOGY, AND SOCIETAL IMPACTS"
Moderated by Michel Ida, CEA Tech
urlz.fr/iqfd

June 16 [Maison MINATEC]
MEET THE SUN TRIP ALPES SOLAR-POWERED BIKE TOUR PARTICIPANTS AND SEE THEIR BIKES
urlz.fr/iqfc

June 21–23 [Maison MINATEC]
LETI INNOVATION DAYS
urlz.fr/iqf9

June 23
[la Casemate science outreach center]
WHAT ARE THE ENVIRONMENTAL IMPACTS OF DIGITAL?
urlz.fr/iqf4

June 23 [château de Sassenage]
MINALOGIC'S SUMMER "DIGITAL DANCE HALL" PARTY
urlz.fr/iqfa

June 27–29 [Maison MINATEC]
EUROPEAN IND TECH2022 CONFERENCE
indtech2022.eu

July 4–5, [World Trade Center]
EUROOCS 2022, THE ANNUAL CONFERENCE OF THE EUROPEAN ORGAN-ON-CHIP SOCIETY
euroocs.eu/annual-meeting

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

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