MINATEC® NEWSLETTER

MINA-NEWS

No. 32
Dec. '14

Top news

Leti sensors used in future bio-artificial liver

The EU FP7 d-LIVER project aims to develop a bio-artificial liver (BAL) support system for patients suffering from liver failure or awaiting a transplant. The project, launched in 2011, brings together a dozen partners, including CEA-Leti, which is supplying sensors for the real-time monitoring of ammonium ions.

Leti's sensors are currently accurate to within 8% to 10%, and the goal is to bring that margin of error down to 3% or 4%. At their present stage of development, the components offer the same level of manufacturability as commercially-available devices. In five rounds of testing at Berlin, Germany's Charité Hospital, including one last month, the device performed well. The measurements taken remained valid after three weeks—the lifespan of the liver cell culture used to make the BAL work.

The final steps in assembling the sensors is completed by hand by hospital staff—a particularly notable detail given the sensors' stellar performance. Because the sensors cannot be sterilized in one go without damaging them, the parts must be sterilized individually and hand-assembled at a sterile lab bench. CEA-Leti researchers personally trained hospital staff in Berlin in both the assembly and measurement tracking processes.

The project partners will now run tests on pathological human serum to demonstrate the BAL's capacity to effectively remove toxins from human blood. If the technology works, it could wind up in hospitals, where it would be used just like today's dialysis machines.

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Innovation

Smart car windshields in full color

CEA-Leti researchers are working with Optys (a Nexter company) to improve smart car windshield technology and get it ready for manufacturing.

Smart windshields display information useful to drivers for an augmented-reality experience at the wheel. The helmet-based system in development includes both data acquisition and projection capabilities. Originally intended for military applications, the system could be of interest to the security, emergency response, and construction markets.

The researchers are currently working on an alternative to the monochromatic hologram system implemented for the research demonstrator that would enable full-color images and lower manufacturing costs.

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Zero-energy elevators just over the horizon

Sodimas, France's leading elevator manufacturer, is teaming up with Schneider Electric and Grenoble Institute of Technology to develop a smart-grid-connected elevator that is powered both by the grid and by alternative energy sources. The R&D is taking place under the EU Arrowhead project.

CEA-Leti is also involved in the project, supplying a virtual platform to coordinate communication between the elevator's command-control system and a Schneider Electric energy optimization module. The system leverages innovative web technologies to transfer the data required for operations while protecting the privacy of manufacturers' other data. An initial demo on a virtual elevator was successful. A second demo, this time on a real elevator, is planned for the project wrap-up in 2017.

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Nanowire-based transistors closing the gap with CMOS

Tunnel-FET transistors offer leakage currents 100 to 1,000 times lower than those of MOS transistors, making them serious candidates in the run for tomorrow's very-low-energy applications. Until now, the transistors had been limited by their on-state currents, which were much lower than for MOS transistors. CEA-Leti researchers overcame this hurdle using nanowire technology. At on-state currents of 760 µA/µm, nanowire-based transistors doubled the previous state of the art, delivering close to the 1,000 µA/µm of traditional CMOS technology.

The new components feature opposite doping for the drain and source, and the channel located under the grid is comprised of a 7-nanometer-diameter silicon-germanium nanowire. Intel and Global Foundry are taking part in the research under the EU Steeper project.

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Innovation

Isotopic tracers provide insight into brain tumors

Last fall Clinatec kicked off a two-year clinical trial on six patients suffering from the most serious form of brain tumor. An amino acid tracer is being administered to monitor certain proteins secreted in the patients' blood—and provide valuable insight into tumor activity.

The results will be used to identify which of the proteins would be useful as biomarkers in determining how the tumor is developing and how it will respond to different treatments. In addition, several hundred proteins circulating in the bloodstream and tumor will be assessed to identify new therapeutic targets.

Prior to the Clinatec trial, isotopic tracers had only been used once on proteins, by a team of researchers in the US in a trial involving Alzheimer's patients.

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CO_2 sensors could become more energy-efficient

A new infrared source that leverages a suspended silicon nitride membrane was the key to CEA-Leti's new energy-efficient CO_2 sensor, which uses six to seven times less energy than current solutions and, with resolutions of a few parts per million by volume, meets the latest indoor and outdoor air quality standards. Plus, measurement times of under a minute make the sensor suitable for most applications.

CEA-Leti's sensor will give LED- and filament-based IR sources a run for their money in a field where energy consumption is a crucial factor. The initial prototype was made using a 3D printer. The researchers will now focus on improvements like bringing in vacuum technology to further reduce energy consumption and integrating the IR source and detector on a single chip.

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Microdisplays beat luminance records

Researchers at a joint lab uniting CEA-Leti and Microoled are developing color OLED microdisplays that could achieve record luminance of 5,000 candelas per square meter with both form factor and energy consumption well under those of LCD displays. The results of the EU FP7 SCOOP project (2011–2013) provided the cornerstone for this latest advance.

Under the SCOOP project, CEA-Leti studied new color OLED and high-luminance architectures and an ultra-thin encapsulation layer able to withstand extreme conditions. The demonstrators produced at the end of the project performed well, bringing home excellent results in terms of colorimetry (with 100% coverage of the RGB triangle), lifespan (up to 1,500 hours at 85°C and 85% humidity), and, of course, luminance (3,000 candelas per square meter for an RGB display).

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Learn more at: http://www.scoop-oled.eu

How sound travels through disordered materials

Researchers from INAC and LiPhy (a CNRS-Grenoble University Joseph Fourier School joint research unit) joined forces to look at how sound travels through disordered materials, with scenarios ranging from perfect crystal to amorphous materials. The simulation-based study, funded by the Fondation Nanosciences, showed that the propagation of sound waves is disrupted by defects just nanometers in size whose mechanical response differs from that of the material as a whole. And more defects mean that vibration-induced excited states have a harder time traveling through the material.

Interestingly, the findings also apply to heat transfer, a discovery that could help in the design of better thermoelectric materials. The symmetry and order of the materials' nanostructure could be optimized to more efficiently carry electricity while minimizing the transfer of heat.

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Bacterial spores exhibit unusual resistance to UV rays

The results of a team of INAC researchers' DNA analyses of bacterial spores that spent 22 months on the walls of the International Space Station have been published in *Astrobiology*. They found that the number of damaged bases increased on par with exposure to UV rays up to a certain threshold at which the number of damaged bases actually *decreased* as UV exposure continued to increase. Additional research on the ground will be carried out with scientists from Germany to further explore the spores' surprising UV resistance.

The research was part of the EU Expose project. The researchers from INAC, who study UV damage to DNA, posit that the UV-resistant spores are a dormant form of bacteria of the utmost scientific importance. In extreme conditions, the spores can shut down all metabolic activity for hundreds of years. And they are also highly resistant to radiation.

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A close-up look at 20,000 individual cells

Researchers at INAC have successfully used a technique initially developed for molecular analysis to observe 10,000 to 20,000 cells at once. The advance hinges on using breakthrough optics to give SPRi (surface plasmon resonance imaging) micrometer resolutions, even for large observation fields. The researchers improved both the plasmon propagation length and image sensor, boosted the image cadence, and corrected optical artefacts.

The next step will be to use their new version of SPRi to observe lymphocyte secretion—which in real-life conditions involves just one out of every 1,000 cells—in real time. By analyzing the phenomenon, researchers hope to identify areas for future exploration in immunology.

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Innovation

Watch nanostructured oxides grow before your eyes

The MOON project, financed by the French National Research Agency (ANR), will reach a major milestone in February, with a second round of testing on the SOLEIL synchrotron near Paris. The researchers, from LMGP and SIMaP*, will use a diffractometer equipped with an instrumented CVD reactor to observe in real time the deposition of ultra-thin layers of zinc oxide on an InGaAs substrate. The researchers will be able to see just about everything, from growth mechanisms and amounts of material deposited to texture, nucleus morphology, and substrate deformation.

The observation will provide a unique opportunity to make improvements during the actual deposition process rather than working blind. The instrumented reactor was validated during an initial round of testing at SOLEIL last May and has since been set up at LMGP where it is used on a regular basis.

*with researchers from Marseille, Metz, and SOLEIL

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Day by day

Pascale Bayle-Guillemaud appointed Deputy Director of INAC

Materials physicist Pascale Bayle-Guillemaud took up the position of Deputy Director of INAC on September 1. She succeeds Armelle Mesnard. Previously, Bayle-Guillemaud had served as head of INAC's microscopy lab at the MINATEC Nanocharacterization Platform (PFNC).

Her responsibilities will align closely with the strategy outlined in INAC's roadmap. Most notably, she will support INAC Director Yves Samson's partnership-building and research-coordination agendas. She will also continue to devote some of her time to her own research, in which she uses microscopy to characterize materials for lithium-ion batteries.

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INAC brings home third Bull-Fourier Award for work on intensive calculation

INAC's L_Sim intensive calculation team has just won its third Bull-Joseph Fourier Award in six years! L_Sim researcher Ivan Duchemin and Xavier Blase from Institut Néel won the award for their work parallelizing a code that describes the light absorption and emission mechanisms of the organic molecules used in objects like smartphone displays.

Until now, the code had been running on a workstation—limiting the available power. Parallel computing will make it possible to simulate the same physical phenomena at the 1,000-atom scale, as compared to 100 previously. INAC's two past wins recognized the lab's TB_Sim transistor-property-prediction code and BigDFT open-source material simulation code (available at bigdft.org).

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Julien Claudon receives CNRS Bronze Medal for his nanophotonics research

Julien Claudon, a research scientist at INAC, won the 2014 CNRS Bronze Medal for his nanophotonics research. Claudon studies controlling the interaction between light and matter within nanostructures.

The optical antennae Claudon developed under a joint research project involving INAC, the Institut d'Optique, and the Technical University of Denmark have already been proven effective at extracting the light from a quantum dot and shaping it into a directional beam. These sources of non-traditional (single-photon) states of light could be useful in quantum information technologies, for instance. Claudon is now investigating ways to control the quantum dot's optical qualities—such as the emitted light's wavelength—by applying a constrained field to the dot.

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Figure of the month

€150,000

This year's EDF Pulse Science and Electricity Award went to Grenoble Institute of Technology faculty member Renaud Bouchet for his research on a promising new solid-electrolyte lithium battery. The international award comes with a €150,000 grant that will be used to finance two additional researchers for the project*.

The new battery is expected to be safer and less expensive and offer greater energy density than lithium-ion batteries. The team's innovation lies in the use of block copolymers in which two polymers are combined by covalent bonding, resulting in synergies between the properties depending on which blocks are chosen. The block copolymers are produced using standard plastics-industry manufacturing techniques. Starting in February, a consortium of manufacturers from France and other countries will begin testing batches of several hundred grams of the copolymer.

*From Grenoble's LEPMI and Marseille's Institut de chimie radicalaire

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Day by day

Publication: *Wide Band Gap Semiconductor Nanowires*

Vincent Consonni (CNRS/LMGP) and Guy Feuillet (CEA-Leti) co-edited *Wide Band Gap Semiconductor Nanowires*, a two-volume, 630-page book published by Wiley-ISTE. Contributions from 44 authors from around the globe cover all aspects of GaN and ZnO nanowires with chapters on the wires' physical properties, growth techniques, integration into heterostructures, and their use in optical devices.

This is the first truly comprehensive work on a hot scientific topic. Several labs around the world are focusing their efforts on nanowires, which offer great potential for a number of applications. Aledia, a start-up founded in Grenoble, is a prime example. The book will be of interest to research scientists, engineers, industrial R&D professionals, and students.

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Learn more at: http://goo.gl/1253eo and http://goo.gl/4BsA7u

Layer-by-Layer Films for Biomedical Applications

Catherine Picart of LMGP has co-edited *Layer-by-Layer Films for Biomedical Applications*, published by Wiley. The 530-page multi-authored volume is intended for graduate and post-graduate students, research scientists, and industrial R&D engineers. Picart, an expert in the subject, worked with co-editors Jean-Claude Voegel of Inserm and Frank Caruso of the University of Melbourne, Australia to compile contributions from an international slate of authors.

While it is certainly not the first book about layer-by-layer films, it is the only one to date to specifically address biomedical applications for the films, whose potential uses include stem cell, drug delivery, vascular and bone devices, and implantable electrodes. Picart's lab focuses mainly on the films and is one of the leading labs in the field, with two patents filed and two European Research Council grants under its belt.

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Learn more about the book at: http://eu.wiley.com/WileyCDA/WileyTitle/productCd-3527335897.html

Interview

Sorin Cristoloveanu, IMEP-LAHC:

"SHG gives us a new SOI wafer characterization technique"

US-based equipment manufacturer FemtoMetrix has just installed its first-ever Second Harmonic Generation (SHG) instrument at IMEP-LAHC. Read on to learn more about this innovative prototype.

SHG is a surface and interface characterization technique for thin layer materials. Here is how it works: A femtosecond laser is focused on the surface of the material. The second harmonic of the signal reflected delivers information like the presence of metal contaminants, imperfections in the interfaces, parasitic charge, and the local electrical field.

The technique is particularly suitable for SOI substrates, whose ultra-thin layers (measuring just nanometers thick) raise challenges like not knowing to which interface the signals measured should be attributed when traditional measurement methods are used.

What spurred FemtoMetrix to set up the prototype in Grenoble?

Grenoble is a hub for SOI R&D. And our lab had worked with FemtoMetrix and Vanderbilt University in Tennessee for more than two years. There was SHG theory, of course, and there had been some informal lab experimentation, but we had to overcome some major hurdles to produce a prototype that could one day become an industrially-manufactured product.

Who gets to use the prototype and what for?

The equipment is at IMEP-LAHC, where it will be used for Ph.D. research starting in early 2015. We plan to characterize as many samples as we can, giving FD-SOI priority. The goal is to determine the metrology rules for the instrument. We are in talks with STMicroelectronics, Soitec, and Leti, and we are open to working with other interested organizations willing to send us their wafers.

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Horizons

Phelma Junior Consultants events a hit

Student organization Phelma Junior Consultants runs a full slate of events designed to help students and businesses get to know each other better. And the initiative has been met with overwhelming success. On October 16, Partners Day attracted 44 companies whose lines of business align with the majors on offer at Phelma. And the series of company and lab tours are systematically overbooked. For example, the 50 slots available for the CERN tour in November were gone just fifteen minutes after registration opened. Upcoming tours include the Synchrotron, ILL, and Alstom Hydro.

The organization's evening lecture series regularly attracts around a hundred students. The October 22 lecture with engineers from Safran brought in an impressive audience of 130.

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Phelma graduate embarks on unusual civil volunteer service mission

Phelma graduate Olivier Llido (class of 2012) is indulging his passion for the French Southern and Antarctic Lands on Île Amsterdam, where he arrived in early November. The 58 sq. km island in the Indian Ocean is one of the most isolated places on earth, inhabited only by the twenty or so scientific researchers Llido will be working with as part of his civil volunteer service with the French Polar Institute.

Llido will be taking part in research on the island's fauna (like sea lions, elephant seals, and albatrosses), but his primary task will be to oversee a greenhouse gas measurement station. Because the island is so isolated, it is an ideal place for measuring gases representative of the quality of our planet's atmosphere.

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Minalogic project brainstorming sessions expanded

Minalogic invites its members to twice-yearly project brainstorming sessions where twenty or so ideas for potential projects are presented. The first session of 2015, scheduled for January 22, will be larger in scope. Representatives of other clusters in the Rhône-Alpes region will also be invited to attend and present either an existing business or R&D project idea.

By expanding the sessions, Minalogic hopes to nurture fruitful new synergies between its own competencies in fields like microelectronics, photonics, and software, and other clusters' interest areas in sectors such as energy, biology, chemicals, environmental technologies, transportation, and textiles. The very popular sessions will still follow the same format with a strict five-minute time limit for each presentation.

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ESRF opens long-term R&D projects to industrial partners

For the first time ever, ESRF has accepted a long-term project submitted by a manufacturer, STMicroelectronics. Starting in January 2015, STMicroelectronics will be eligible for 20 days' use of the beamline over three years to conduct very-high-resolution characterization of defects on 3D electronic components. Leti will be assisting with the characterization.

Until now, only academic researchers could apply for long-term projects. STMicroelectronics' request comes following ESRF's modernization program—the facility now has an X-ray beamline unlike any other worldwide, with resolutions of 20 nm.

The new beamline can be used to observe defects deep inside copper pillars, direct bonds, and embedded systems. Electron microscopy, which offers resolutions of 1 nm, limits observation to the surface of these and other components.

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Horizons

New in biomaterials: observing bone regeneration in 3D

Amy Wagoner Johnson, a leading American biomaterials scientist, has been working on site at LMGP since July under the Fondation Nanosciences chair of excellence program. Wagoner Johnson's research focuses on cell-to-cell and cell-to-biomaterial interactions in bone repair and regeneration processes. And her work stands out in two ways. First, she creates realistic microenvironments in the form of rigid 3D substrates covered with biomaterials and, second, she conducts both *in vivo* and *in vitro* experiments in a unique iterative process.

High-definition electron microscopy, fluorescence microscopy, and confocal microscopy are being used to study these biomaterials at the micro- and nanometric scales. Scientists from four Grenoble-based labs* are involved in the three-year program.

**LMGP, IAB, SIMAP, and Liphy*

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Maryline Bawedin joins IMEP-LAHC

Maryline Bawedin, an expert in characterizing and modelling advanced CMOS components, has joined IMEP-LAHC as lecturer. She had previously completed her Ph.D. dissertation there, following degrees from Liege and Louvain Universities in Belgium. She later completed post doctorate studies at Cambridge before moving on to a position at the University of Montpellier, where she stayed for four years.

Bawedin has been assigned to a project on SOI-based DRAM volatile memory, which uses a transistor only rather than a transistor and capacitor. And, under the EU Minos project, she will also investigate the ultimate limits of miniaturization for CMOS-on-SOI components at the 10 nm node. IMEP-LAHC is home to a complete range of characterization equipment that will be useful in this research.

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Live from MINATEC

Nanocharacterization Platform gets micro Raman equipment

The Nanocharacterization Platform (PFNC) now has two micro Raman instruments for measuring the chemical, mechanical, structural, and electronic properties of thin-layer materials. The measurements, down to the nanometric scale, can be taken with or without prior sample preparation, either locally or by 2D or 3D mapping. The wavelengths available range from near UV to near IR for exploring various materials of different thicknesses.

The primary benefit of micro Raman equipment is speed. While interpreting the spectra is a complex task, the spectra themselves are obtained within just seconds or, at most, minutes. Over the past several months the equipment has been used to characterize semiconductor materials for PV, microelectronics, and lighting applications.

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Hyperlight, the latest artist-in-residence project at Atelier Arts-Sciences

Artist and engineer Thomas Pachoud unveiled his first-ever work using the Hyperlight system—the focus of Pachoud's artistic residency at the Atelier Arts-Sciences—at the Experimenta fair held at Maison MINATEC, to music created by composer David Guerra.

The 30-year-old Pachoud uses an innovative modular holography system he developed himself to transform light into living performances. He directs beams of light through a smoke-filled space, aligning them in parallel, making them converge, or moving them away from each other. The result is an unusual tableau of perspective in motion.

And the unveiling of Hyperlight at Experimenta gave just a hint of what Pachoud's full-length performance—expected to be completed in 2016—will look like. So, stay tuned for more!

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300 mm cleanroom to get new equipment in 2015

The 41.02 building's cleanroom, which inaugurated a third extension this summer dedicated to 300 mm microelectronics activities, now offers some 2,200 Sq. m of research space.

The new 500 Sq. m space will house new microelectronics fabrication resources such as deposition and thin-layer etching equipment.

CEA-Leti, which is managing the procurement process, hopes to begin installing and using the new equipment over the course of 2015. The 41.02 building's clean room has never shut down—not even during the colossal construction work to build the extension, which included reinforcing the building's steel frame and installing a new air delivery plenum and air recycling units on the building's façade.

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CEA puts the lid on .zip files

At the end of September the CEA rolled out an initiative to block any .zip-type folders containing .exe files attached to incoming emails. The senders are automatically alerted that their email didn't make it past CEA security.

The anti-zip measure came in response to an increase in the number of security breaches caused by .exe files hidden in compressed folders. And email, whether it is through attachments or embedded links, constitutes one of the primary—and most dangerous—channels for disseminating malware. In one recent incident, a file named *Avis de Paiement.exe* containing malware was sent to some 4,600 CEA email addresses and was opened 200 times, resulting in days of extra work for the IT department to get all affected equipment running normally again.

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Live from MINATEC

Carnot supported 43 new energy technology projects in 2014

On January 13, 2015 Institut Carnot Energies du futur will present the joint research projects in the field of new energy technologies it supported in 2013–2014.

Once again this year Institut Carnot Energies du futur is one of the leading Carnot institutes in terms of technology transfer. It boasts an annual consolidated operating budget of €190 million, €64 million in annual revenue from R&D contracts, and nearly 700 scientific publications and 220 new patents per year. The institute is a consortium of CEA-Liten labs and academic labs from Grenoble Institute of Technology, Grenoble University Joseph Fourier School of Science, and CNRS. Former LMGP Director François Weiss took up the directorship of the institute last February.

This year was marked by a large number of projects in the field of energy-efficient buildings. Next year the institute will focus its scientific pump-priming efforts on hydrogen-energy research.

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More than 400 companies participated in SEMICON Europa

Major global semiconductor industry trade fair SEMICON Europa was held in Grenoble for the first time ever this year. Turnout far exceeded expectations, with the number of exhibitors up 18% over 2013, and the number of visitors up 28%. The event kicked off on October 7 in the presence of the French government's Secretary of Research Geneviève Fioraso and local political and civic leaders.

The fair offered up two innovations this year, the Cluster area and the Innovation Village. A total of 30 European start-ups (including Grenoble's own Aryballe Technologies, IRLynx, Exagan, and others) were selected by an international panel of investment experts to participate in the Innovation Village.From now on, the fair will alternate between Dresden and Grenoble every other year—so mark your calendars for Grenoble in 2016.

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Microoled ships its 100,000th display

Microoled, located at MINATEC, designs and manufactures high-definition, low-power microdisplays that leverage a technology developed in partnership with CEA-Leti. The rapidly-growing start-up, which is now seven years old, has shipped more than 100,000 displays since 2012.

From its inception, Microoled has set its sights on a wide range of consumer and BtoB markets in France and internationally, with the potential applications for its microdisplays encompassing healthcare, defense and security, camera viewfinders, connected glasses, and shooting and hunting lenses. Today, 99% of the company's revenue comes from export sales. And the company is planning additional investments and an expanded sales staff in the US and Asia by 2017. By then Microoled's balance sheet will be in the black and the start-up will be all grown up!

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Agenda

Until December 5, CNRS Auditorium (rue des Martyrs)
2014 Dautreppe Seminar on Matter and Symmetry
http://symetries2014.grenoble.cnrs.fr/

December 3, Maison MINATEC
Minalogic Business Meetings
http://goo.gl/eIrg1A

December 5, Maison MINATEC
Sport2Job, tthe first intercompany multisport challenge, open to both able-bodied and disabled athletes
Contact: contact@sport2job.fr

December 19, Maison MINATEC
Special Christmas Midi MINATEC
brown bag lunch with the Polygone scientifique orchestra
http://www.minatec.org/midis

January 19, 2015, Besson Auditorium (Phelma Campus)
Science Day and MET-FEG inauguration
To register: patricia.donnadieu@grenoble-inp.fr

January 19–21, Grenoble
2015 European 3D TSV Summit - Enabling Smarter Systems
Organized by SEMI Europe
http://www.semi.org/eu/node/8566

January 22, Grenoble WTC
Minalogic Project Brainstorming session
www.minalogic.com

February 5, Maison MINATEC
Scientifique toi aussi ! (4th edition)
pauline.martin2@cea.fr

February 3, Maison MINATEC
Leti–DOPT Annual General Meeting
sylvie.fournier@cea.fr

February 4, Maison MINATEC
Leti–DACLE Annual General Meeting
armelle.dekerleau@cea.fr

February 23, Maison MINATEC
Leti–DTSI Annual General Meeting
fabrice.geiger@cea.fr

February 26, Maison MINATEC
Leti–DCOS Annual General Meeting
josette.mounier@cea.fr

March 6, Maison MINATEC
7th Junior Scientist and Industry Annual Meeting
Ph.D. candidates and postdocs, introduce yourself in a 15-second video!
http://www.jsiam-giant-grenoble.org/

March 16–18, 2015, Maison MINATEC
LabEx MINOS Workshop
http://labex.univ-grenoble-alpes.fr/actualites/2014-07-10/decouvrir-labex-minos-wokshop

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No. 32 Dec. '14

MINA-NEWS is published by MINATEC, 3 parvis Louis-Néel, 38054 Grenoble Cedex 9 France
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English translation: SFM Traduction