

Top news

Non-destructive surface testing goes 50 nm deep

In a world first, a team of French and Danish researchers from Leti and STMicroelectronics successfully performed non-destructive testing on a CMOS stack layer embedded at a depth of more than 50 nm, locating it to within 10% accuracy.

The team, working at ESRF, used X-ray photoelectron spectroscopy—a method until now used exclusively for extreme surface testing (depths of less than 10 nm). The researchers combined their method with a quantitative signal processing algorithm for energy losses; the algorithm could potentially be used in a clean room for testing closer to the surface.

A generic, non-invasive method

This breakthrough opens new doors for the characterization of nanocomponents. These components typically contain stacked layers, and engineers need to be able to check the layers' interface quality and depth after fabrication. Engineers also need to be able to measure the depth diffusion of ultra-thin layers.

The new X-ray photoelectron spectroscopy method can do all of the above, with three major advantages: it is non-destructive; it is non-invasive (the materials are not altered); and it does not require any sample preparation. Moreover, it can be used on a wide range of components like CMOS III-V, transistors, and memory.

The method was initially used to analyze 56-nm-deep layers in CMOS stacks made by STMicroelectronics. Now researchers are working to enhance the method, which can probably reach depths of up to 100 nm.

Contact: olivier.renault@cea.fr

Innovation

Gold nanoparticles help fight brain tumors

Imagine eradicating brain tumors by injecting them with gold nanoparticles and activating the particles with synchrotron radiation. That's the groundbreaking new approach being developed at ESRF by researchers from INAC and INSERM. They successfully tested the new procedure on rodents, improving survival rates significantly compared with a control group treated with radiation alone. Because the gold nanoparticles absorb more low-energy radiation (88 keV) than their environment, the radiation targets the nanoparticle-rich tumor cells and leaves the healthy tissue alone.

The researchers hope their new method can eventually be used to treat glioblastomas, which are currently incurable. The average life expectancy for people with this type of brain tumor is 15 months—a mere 3 months longer than it was 20 years ago.

Contact: jean-luc.ravanat@cea.fr

Bacteria stand out under ultra-sensitive NMR

Dynamic nuclear polarization (DNP)—which increases the sensitivity of nuclear magnetic resonance (NMR) by anywhere from 10 to 1,000 times—is once again making headlines. It was used by scientists from INAC and IBS to observe the cell walls of living bacteria, versus the conventional technique of looking at wall samples taken from a cell. This breakthrough could lead to the development of new antibiotics.

In traditional NMR, a cell wall's signal is difficult to distinguish from that of the rest of the cell. That's why scientists have to work with cell wall samples. But by using a free radical as a polarizing agent that preferentially attaches to the cell wall, scientists can obtain important information about the wall's structure, dynamics, and *in vivo* interactions with the rest of the cell.

Contact: sabine.hediger@cea.fr

Dye-sensitized solar cells achieve over 10% yields

With a 10.2% energy conversion yield versus 6% for the previous generation, the dye-sensitized solar cells developed by INAC researchers have set a new standard. Their solar cells use organic dyes with an absorption coefficient some three times greater than those used in conventional dye-sensitized solar cells. And their organic dyes don't contain ruthenium, an expensive rare metal that can generate toxic chemical derivatives.

The 10.2% yield was achieved during tests carried out by two joint venture partners, and places INAC's dye-sensitized solar cells among the most efficient in the world. They are also remarkably stable, with no observable deterioration after 2,000 hours of accelerated aging. The researchers also used their dyes in a novel electrode material developed by a South Korean laboratory, with a performance here again close to the state of the art.

Contact: renaud.demadrille@cea.fr

MINATEC NEWS

No. 26
Oct. '13

Innovation

Manipulated images fool detection systems

Using advanced image restoration techniques, miscreants can now fool detection systems into thinking manipulated JPEG images are the real thing. That's the unsettling finding of research done by four engineers from Gipsa Lab and Peking University, who won the Best Paper Award at a June conference.

Existing detection systems work by spotting statistical "footprints" left by JPEG compression when one image is inserted into another. The engineers were able to evade these systems by aggregating their different action models to develop a restoration model that can pass undetected. Thus the cat-and-mouse game between fraudsters and detection systems continues. But it's not just child's play—in March North Korea's doctored photos of its supposed military hovercraft made news headlines around the world.

Contact: francois.cayre@gipsa-lab.grenoble-inp.fr

Quantum dots blow their own horns

Researchers from INAC and the Technical University of Denmark have developed a trumpet-shaped microscopic antenna that can extract 75% of the unique photons from a quantum dot and emit them in a Gaussian optical beam. The beam can then be effectively injected into an optical fiber for applications in cryptography, metrology, and quantum computing, for example.

The antenna is made by plasma etching and is 12 microns long. It fans out gradually from a 200 nm diameter at the base and a 1.6 micron diameter at the tip, enabling it to send out a directed light beam with a Gaussian transverse profile. The researchers' "photon trumpet" can also be used in the opposite direction—a photon from an optical fiber can be absorbed very effectively by a quantum dot.

Contact: julien.claudon@cea.fr

Hydrogen catalysis may be possible with enzymes instead of platinum

Could enzymes like hydrogenases be used instead of costly platinum as hydrogen catalysts? The answer could be yes, according to research published in the July issue of *Nature* magazine. A team of scientists* has developed a reacting agent that completely activates a previously inactive hydrogenase. This hydrogenase is used by micro-organisms that rely on hydrogen for energy—meaning it could potentially serve as a hydrogen catalyst.

Until now complicated biological machinery was needed to activate the hydrogenase, so the discovery of a simpler pathway is an exciting development. Natural or artificial hydrogenases could serve as much cheaper alternatives to platinum for fuel cells and hydrogen production.

*From CEA, Collège de France, CNRS, Grenoble University's Joseph Fourier School, and two German laboratories

Contact: marc.fontecave@cea.fr

Day by day

Grenoble proud to host *Conférence des grandes écoles* for the first time

Some 200 presidents from France's top-tier universities will come to Grenoble on October 10–11, 2013 for a meeting of the prestigious *Conférence des grandes écoles* (CGE). The meeting will be hosted by Grenoble Institute of Technology and Grenoble Ecole de Management, and will take place on the Phelma campus. This year's theme, "Innovation and value creation at France's leading schools," was chosen to commemorate CGE's 40th anniversary.

The main goal of the meeting is to give participants a forum for sharing best practices for building an innovation ecosystem. The meeting will include panel discussions with opinion leaders from academics, research, industry, and politics, as well as tours of Grenoble's research centers and technology platforms. French Minister of Higher Education & Research Geneviève Fioraso will give the closing speech.

Contact: nancy.eichinger@grenoble-inp.fr

Four-junction concentrated solar cell delivers 44.7% yield

Engineers from Soitec, Leti, and Germany's Fraunhofer Institute for Solar Energy Systems have developed a four-junction concentrated solar cell with an energy conversion yield of 44.7%—with the potential to reach yields as high as 50% in the coming years.

Currently the world record is a 44.4% yield, but the technology involved will soon reach its limits. It relies exclusively on epitaxy junctions, which means that once a solar cell has more than three junctions it becomes difficult to combine lattice mismatched crystals without deteriorating material quality. The engineers were able to overcome this obstacle by using a molecular bonding technology developed by Soitec and Leti. The technology was initially developed on silicon and has recently been applied to solar cell junctions—resulting in multi-junction cells with exceptional efficiency.

Contact: thierry.salvetat@cea.fr

Coming soon: a fully-microelectronic CO₂ sensor

Leti is planning to develop an optical CO₂ sensor using all-MEMS technology, including an emitter, detector, and infrared optical system. It will be no bigger than 1 cm³ and require no more than 6 mW of power. This will be the first step towards an even smaller sensor that could be used in cell phones, for example. The CO₂ sensors currently on the market are around 20 cm³ and assembled by hand.

In 2012 Leti developed an innovative demo sensor under the EU HOMES project. That sensor uses infrared-on-silicon, and delivers 100 ppm resolution with a mere 6 mW power requirement. Both STMicroelectronics and IBM expressed interest in the prototype, which was what encouraged Leti engineers to take their work even further.

Contact: luc.andre@cea.fr

Day by day

Zero PoVa project tackles quantum nanoelectronics

The Zero PoVa project (for zero power, zero variability) is a 5-year project launched on June 1, 2013 to develop CMOS components for the post-2026 era. Some 20–25 researchers from INAC, IRAMIS, and the CEA's Technological Research Division are working on the project, which boasts a €1.3 million budget for the first year alone (excluding staffing).

By 2026 transistors will probably be only 5 nm long with channels that let only one electron pass through at a time under low voltage. And they will likely use 100 times less power than they currently do. Achieving this goal poses significant scientific hurdles that only technological pump-priming can help overcome—and that's just what the research team has set out to accomplish. Leti has already launched 200 mm and 300 mm runs, while INAC has invested in a probing station exclusively for this project. Six post-docs will also be brought on board this year.

Contact: marc.sanquer@cea.fr

Day by day

Grenoble Institute of Technology-Phelma restructures its biomedical program

The Grenoble Institute of Technology-Phelma program in Systems and Microsystems for Physics and Biotechnology is now ten years old and ready for an overhaul. Starting this year the program will focus primarily on biomedical engineering, and the 48 students starting the program this fall will all follow the same curriculum—instead of being divided into two tracks like before. The program will eventually be renamed Biomedical Engineering.

All the courses may eventually be given in English and some already are. In the second semester students choose between two majors: Medical Treatment & Imaging and Nanobiology & Medical Systems. Program graduates typically find jobs at large companies and start-ups, both in France and abroad. Nearly a third of them go on to get a PhD—making them highly coveted by the biomedical industry.

Contacts: franz.bruckert@phelma.grenoble-inp.fr
respsmpb@phelma.grenoble-inp.fr

Grenoble Institute of Technology-Phelma packs in a full freshman class

Grenoble Institute of Technology-Phelma welcomed 382 freshmen to its campus this September, along with ten students in the new micro and nanoelectronics integrated system design work-study program. This year's total intake is more than 10% bigger than last year's. Grenoble Institute of Technology-Phelma is continuing to gain recognition as a world-caliber engineering school. The school's entrance exam ranking shot up this year—especially for the Math & Physics track—evidence of increasing competition for available slots. This no doubt reflects its rating by *L'Étudiant* magazine as France's 17th-best engineering school.

Some 9% of this year's freshman class were accepted based on their prior diplomas (mainly from two-year university technology programs) and nearly the same percentage came through Grenoble Institute of Technology's own prep program.

Contact: jean-michel.missiaen@phelma.grenoble-inp.fr

Real families test energy-independent homes

How do households manage their electricity use when all their energy comes from solar power? To find out, a Grenoble research team sponsored by MINATEC IDEAs Laboratory and IRT Nanoelec asked ten families to live in solar-powered homes for three winter months.

The families were asked to compare their actual energy use with the amount of energy that would have been stored in a solar-panel-fed battery, and adjust their energy use accordingly. All ten families proved to be good sports—they took shorter and less frequent showers, adapted their activities to weather conditions, and did their laundry when power was most available. French gas utility GDF Suez, a project partner, is now studying the families' consumption curves to get a better feel for today's consumers' usage patterns.

Contact: philippe.caillol@cea.fr

Horizons

STMicroelectronics and Grenoble Institute of Technology-Phelma strengthen partnership

On July 4 Grenoble Institute of Technology-Phelma and STMicroelectronics signed an agreement that will bolster their research and education partnership. Students will now have access to various STMicroelectronics application cards and components for their lab classes, and STMicroelectronics employees will give guest lectures to round out students' core courses.

Currently, more than a hundred students complete internships or culminating projects at STMicroelectronics. The company now also supports the school's engineering degree program by providing expertise in integrated micro- and nanoelectronics systems design.

Contact: relations.entreprises@phelma.grenoble-inp.fr

Horizons

GIANT opens its doors during 2013 Science Week

For the first time ever, the GIANT innovation campus will open its doors during France's national science week. On Saturday, October 12, visitors will be able to experience a "science pathway" with several circuits: the Science Fair pathway, as well as "Celebrating Physics" (CNRS), "The Science of the Infinite x 2" (LPSC), and "Exploring Matter" (EMBL, ESRF, ILL).

On Friday, October 11, school groups will be able to visit the Science Fair and the Experimenta arts-science-design fair co-organized with MINATEC and held on the MINATEC campus. This year's events will be able to accommodate even more visitors thanks to additional workshops like "Superconductors in Levitation, a Roller Coaster Ride," and "Mother Nature's School of Chemistry." Some 460 school children from Grenoble, Briançon, Romans, and Chambéry have already registered to attend.

Contact: marie-helene.duluc@cea.fr

Professor Alim-Louis Benabid earns recognition for Parkinson's research

Alim-Louis Benabid, MD, PhD, and Chairman of Clinatec, recently won an award from the Michael J. Fox Foundation for leadership in Parkinson's research for his pioneering work on deep brain stimulation (DBS). The technique involves inserting electrodes into the patient's brain to send an electrical pulse that eliminates neurological symptoms of the disease. More than 100,000 patients around the world have received DBS surgery, which dramatically improves quality of life.

The award comes with a grant of €75,000, which Benabid donated to Clinatec (which he co-founded in 2006). Benabid is also a Professor Emeritus at Grenoble University's Joseph Fourier School and served as head of neurosurgery at Grenoble University Medical Center from 1989 to 2007.

Contact: corinne.mestais@cea.fr

Start-up incubation thriving at MINATEC

The economic crisis appears to have spared MINATEC, where an impressive seven start-ups are currently in the incubation phase: Akrisiv France (Lipidots), Hexagan (materials for power components), Infuz (data fusion), NatchIT (digitization of handwritten notes), Genel (functional genomics), OLED4Life (OLED lighting), and Enerbee (energy harvesting).

The majority of these projects are spearheaded by local researchers, who, in most cases, join forces with business experts to take their idea from the lab to the marketplace. And MINATEC labs are teeming with projects in the maturation phase—evidence that MINATEC's awareness-raising efforts and support programs are paying off!

Contact: alain.briand@cea.fr

Interview

Philippe Michallon,
Head of SPICE*

We want to leverage our showroom to better promote our technologies

You have several initiatives underway for your showroom. What are their key aims?

Between 5,000 and 6,000 people visit our showroom every year, 90% of them from outside the CEA. It's been a huge success and we want to leverage that further by staying in closer contact with companies after they visit. Managers usually walk away from our showroom highly impressed and eager to work with us. The showroom also gives CEA researchers a chance to see their colleagues' developments and prototypes.

Your most original initiative is undoubtedly the premium showroom. What was the idea behind that?

The goal is to invite companies to a post-visit debriefing meeting, facilitated by a creativity consultant, to help them identify new customer needs or products based on the services we offer at the CEA. Then we work them to formalize their ideas—for new products or joint ventures, for example—in an "innovation roadmap." The managers leave the meeting with R&D ideas and a list of the right contacts at our laboratories, and we leave with a better understanding of their needs.

You have also introduced two new marketing tools.

Yes, all our business developers now have a virtual showroom on their laptops. This lets them show contacts our various research topics and prototypes; users can simply click on a prototype to obtain more information. Our other new tool is K'net, an area in the showroom's entranceway with temporary displays of new technology and prototypes and with videos on the CEA's know-how and achievements.

*The CEA's user-centered innovation department (Service Pour l'Innovation Centrée Expérience utilisateur)

Contacts: philippe.michallon@cea.fr
lydie.roure@cea.fr

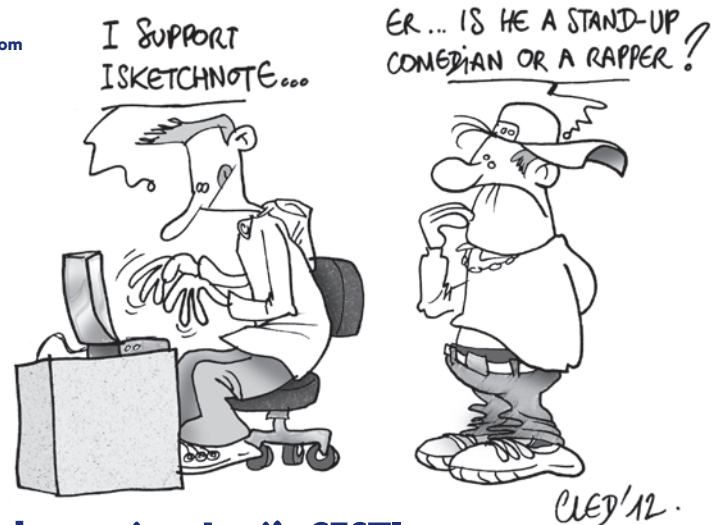
Horizons

Grenoble-based iSketchnote turns to crowdfunding to raise capital

ISKN, a Leti start-up currently in the incubation phase, has decided to use the crowdfunding site www.kickstarter.com to raise capital for its iSketchnote project—the first-ever Grenoble-based start-up to use crowdfunding to obtain financing. Potential investors have until October 9, and the minimum investment is \$1. And, participants who invest a minimum of \$30 will receive three ISKN pens in a few months. An investment of \$119 (around €90) will get you three pens plus a 40% discount on a functionalized iPad cover that enables you to digitize your handwritten notes.

ISKN had hoped to raise \$35,000. As of September 26, the project had brought in \$230,000. In addition to raising capital, crowdfunding has been a great way for the company to test market segmentation and product acceptance, boost brand image, and gear up for a new round of fundraising planned for early 2014.

Contact: contact@isketchnote.com
Learn more at: www.isketchnote.com



Smart-card security: Leti's CESTI earns EAL7 accreditation

Leti's CESTI (center for IT security evaluation) recently earned Evaluation Assurance Level (EAL) 7 accreditation. The center, which is active in France's certification systems, can now evaluate the security of all smart-card-type products with the highest international Common Criteria requirements.

The EAL7 accreditation requires the center to perform a formal design analysis on product security features and verify the corresponding results. The accreditation recognizes the center's expertise in the field of security evaluation.

Samsung was the center's first customer to request EAL7, the highest level of accreditation, and, in March 2013, became the world's first manufacturer of secure microcontrollers to obtain the EAL7 assurance.

Contact: elisabeth.crochon@cea.fr

Live from MINATEC

The Nano@school website now online

Nano@school, a fun, hands-on program to teach high-schoolers about micro and nanotechnology, now has its own website: www.nanoatschool.org. The website (in French only) is intended for both students and teachers, and includes information about the program and participant testimonials—including two videos produced by high-school students. The website also includes a secure area where teachers can download instructional materials to help them prepare for their field trip to CIME Nanotech.

Along with launching a new website, the Nano@school project partners (Grenoble Institute of Technology, CEA, Grenoble University's Joseph Fourier School, and the Grenoble School Board) have also designed a new logo and filed a trademark, effectively taking their communications to the next level. Nano@school has been running for five years and serves some 400 high-schoolers each year.

Contact: contact@nanoatschool.org

Live from MINATEC

Winners, pack your bags!

In late October, the three Grenoble area high-school students who won the first French-American Young Innovators Award will head off for a week in California for a program that includes a tour of the Xerox Palo Alto Research Center.

The Award was set up by the U.S. Consulate in Lyon to reward talented local high-school students studying science and technology. Contest participants were asked to answer the question, "Could we walk on water?"

The contest will be held again in 2014. Its sponsors are CEA-MINATEC, Xerox (through its European Research Center in Meylan), the Grenoble Science Education Center (CCSTI), the Lyon- and Grenoble-area school boards, and the European-American Chamber of Commerce.

Contact: alexandrine.sadoul@cea.fr

Seven projects selected for the 2013 Challenge First Step

Of the thirteen projects submitted in June for this year's Challenge First Step (to support promising business ideas), seven were selected: three from Leti and four from Liten. The winners were announced at a kick-off meeting on September 11. The budding entrepreneurs will now begin the business incubator program with a one-week residential training course on business plans, given by a consultant. They will work in groups of two or three to apply the tools and methods they learn during the course on three "focus" projects chosen by the selection committee for their excellence, originality, and suitability for use as case studies.

The entrepreneurs will submit their funding requests in February 2014. The committee can grant each worthy project up to €150,000 for six months, depending on the project's funding requirements.

Contact: stephane.fontanell@cea.fr

Five Grenoble business ideas win French government funding

So far 2013 has been a great year for MINATEC start-ups: five were selected to receive funding under the French government's innovative new business stimulus package.

INAC is behind one of the start-ups, LXRepair, which makes diagnostic tests that can be used to develop personalized cancer treatment protocols. The four others were spun off from Leti: Avalun, which has developed portable multi-measurement diagnostic devices to monitor chronically ill patients; Primo 1 D, which creates electronic functions on plastic or textile threads; Elmess, which produces complex objects using mineral materials; and Oled4life, which supplies organic LEDs for signage and control panels.

Last year Elmess and Oled4Life won funding under the 2012 Challenge First Step—a testimony to the Challenge's ability to spot and incubate the brightest new ideas.

Contact: alain.briand@cea.fr

Learn more about advanced characterization

A conference entitled "Advanced Characterization Techniques: Opportunities for Industry" will be held on November 14 at ILL as part of IRT Nanoelec programming. The conference is open to both researchers and students, but will mainly target professionals from the world of industry seeking to learn more about materials characterization and what Grenoble's characterization resources—from labs like PFNC to large instruments like ILL and ESRF—can do for their business.

Professionals from the world of industry will talk about their own experiences, while researchers from Grenoble Institute of Technology, CEA, ESRF, and ILL will explain the technology. The goal is to open the door to future industrial R&D projects. The day will end with tours of the facilities.

View the program and register at: <http://goo.gl/MoNMM7>
Contact: didier.pellegrino@grenoble-inp.fr

Agenda

October 7–11

**Annecy
MNPC'13**

Meeting on Conjugated Materials and Nanostructures

<http://mnpc2013.sciencesconf.org/>

October 10–11

**Phelma Campus
40th Meeting of the**

Conférence des grandes écoles

Theme: "Innovation and value creation at France's leading schools"

Contact: nancy.eichinger@grenoble-inp.fr

October 12

MINATEC Campus

**Science Fair and
the Experimenta Arts-Sciences**

Fair as part of 2013 National Science Week

Contact : marie-helene.duluc@cea.fr

October 17

**Grenoble Institute
of Technology-Phelma**

Partners Day

Jean-marc.dedulle@grenoble-inp.fr

November 12

**Maison MINATEC
Technoparade 2013**

Information, presentations, and discussions on recent developments in nanotechnologies and nanocharacterization in Grenoble

<http://www.fondation-nanosciences.fr/RTRA/fr/720/131112-technoparade.html>

November 14

**Institut Laue-Langevin
Conference on advanced
characterization techniques**

for professionals from the world of industry

Program and registration: <http://goo.gl/MoNMM7>

December 4

**Maison MINATEC
OMNT Nano H2**

seminar on nanoconstruction for hydrogen energy and fuel cells

<http://omnt.congres-scientifique.com/decembre2013/>

contacts

MINA-NEWS >

MINA-NEWS is published by MINATEC, 3 parvis Louis-Néel, 38054 Grenoble Cedex 9

Head of Publication: Jean-Charles Guibert; Editor in Chief: Irina Gafton

Correspondents: Philippe Laporte, Leti, philippe.laporte@cea.fr -

Colette Lartigue, Phelma, colette.lartigue@inpg.fr - Nathalie Mathieu, FMNT, nathalie.mathieu@inpg.fr -

Jérôme Planes, INAC, jerome.planes@cea.fr - Irina Gafton, MINATEC, irina.gafton@cea.fr -

Alexis Sableaux, Phelma, alexis.sableaux@phelma.grenoble-inp.fr

Editing: Benoit Playoust and Bénédicte Magne; Layout: Philippe Tur; Printing: Format Éditions

English translation: SFM Traduction