

Event

Yes, topological insulators do exist

Do topological insulators—substances that act like insulators on the inside but whose surface contains conducting states—really exist?

It would appear so based on experiments conducted on quantum wells just a few nanometers thick, but the findings are difficult to apply to three-dimensional objects. However, now a CNRS-Leti research team has discovered these surprising properties on a sample they created that is several tens of nanometers thick.

This research will be developed further under a new project called Semitopo, to be funded by the French National Research Agency. Semitopo will focus on the characterization and optimization of these first “made in Grenoble” topological insulators; the Synchrotron will be used to take measurements.

The topological insulators are made of constrained layers of mercury telluride deposited on cadmium telluride substrates. The first challenge was to make the insulators; Leti had to draw on its 30 years’ experience in molecular beam epitaxy, a process developed—and continually being improved—for Sofradir infrared imaging systems. Scientists at Institut Néel then characterized the insulators using transport measurements.

The study of topical insulators also has applications in applied research. Since they are able to carry a spin current without a magnetic effect, they can be used to make spintronics and, eventually, quantum computers.

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Innovation

The cyber security arms race continues

Leti’s cyber security research team recently presented the latest findings of its research into two attack mechanisms: lasers and electromagnetic disturbances. This 30-person team of experts has been looking specifically at hardware, now a prime target of cybercrime and, therefore, a cornerstone of enhanced security. The goal is to develop methods for keeping physical equipment—electrical devices, smart grids, and command and control systems—free from the ravages of cyber attacks.

To stay ahead in this “arms race,” the Leti team is looking at both cyber attacks—in order to better understand the threat—and system security. The team presented a new security method using physical unclonable functions to civil and military experts at Leti’s most recent Annual Review. This new method gives each physical structure a unique “signature,” thereby making it easier to detect clones.

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Real-time, stress-free cell sorting

If you hybridize a macromolecule made of a short oligonucleotide and an antibody on the probes of a DNA chip, you get a biochip that can recognize things like cells and bacteria. This is exactly what an innovative research team at INAC recently did to develop a method for capturing blood cells involved in the human body’s immune response. Their unique biochip can also free these specific cells for additional analyses, thanks to restriction sites on the probes’ DNA. In this process the blood cells are not exposed to any chemical, thermal, mechanical, or radiation stress.

The goal of this research is to develop a “bedside” diagnostic tool, but several more years of work lie ahead before the technology will be reliable and cost-effective enough.

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Slow-wave propagation lines on nanowire membranes

An IMEP-LAHC research team has developed a new type of slow-wave propagation line for circuits operating at millimetric and radio frequencies (3 GHz to 300 GHz). The lines are fabricated in a clean room and made of a metallic nanowire membrane enclosed in an aluminum oxide substrate. They range in thickness between 50µm and 1mm.

This type of nanowire membrane is already used in molecule filtration. It has all the advantages of a slow-wave line: it can cut circuit size by a factor of two or three; it is cheaper than a conventional microstrip line; and it performs better thanks to a higher quality factor. The research team has filed a patent for its invention.

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Innovation

An artificial kidney with its own measuring system

A Leti research team working under the FP7 Nephron project has developed an embedded system for measuring the concentrations of key dialysis solution ions (like sodium, calcium, potassium, phosphorus, and urea) before and after the solution passes through an artificial kidney. This measuring system includes a five-electrode electrochemical sensor and control software to test the equipment and characterize the sensors.

The main innovation in Leti's measuring system is that it is embedded: an electronic chip converts the pressure data recorded by the sensors into ion concentrations. Moreover, the system can run on just 4 mA of current, meaning that it does not need to be plugged into a power supply.

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Better treatment for breast cancer relapses

Thanks to Lymphodivpenia, a biomarker developed by Grenoble-based ImmunID, doctors can offer more targeted treatment to metastatic breast cancer patients suffering from a relapse. This is the main conclusion of research published in *Oncoimmunology* in July 2012, and confirms the findings of two previous studies. A total of 133 patients have been tracked so far.

Lymphodivpenia lets doctors estimate the three-year survival probability of cancer patients and determine the best treatment option, either conventional chemotherapy or chemotherapy following treatment to strengthen the patient's immune system, and the best clinical care. These findings—a first for metastatic cancer—are currently being confirmed on a larger patient sample.

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Why electrodes in lithium-ion batteries fail

A recent study at INAC confirmed what scientists had already suspected: the main reason why electrodes in lithium-ion batteries fail is because the lithium builds up and gets "stuck"—no longer playing its role in charge transfer.

The scientists tested their hypothesis using NMR, and designed their experiments so that the iron in the material would not scramble the NMR spectra on the samples. While these experiments confirmed the reason for electrode failure, the NMR data cannot currently be used to predict whether a sample will be successful before cycling.

This study also allowed scientists at Liten to test different electrode materials from different suppliers.

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Breakthrough in measuring nanostructure dopant energy spectra

One of the key challenges of nanoelectronics is measuring dopant energy spectra in silicon nanostructures, because at this scale energy levels depend largely on the surrounding environment—and the in situ measurement of a single dopant is extremely difficult.

However an INAC-Leti team of researchers seem to have found a way to overcome this hurdle. They have developed a three-grid nanometric system that can be used to couple or individually control two phosphorous dopants to align their ground and/or excited energy states. By quantum tunneling through the two dopants in series at a temperature of 4K, scientists were able to measure the energy difference between each dopant's ground and excited energy states. These findings were published in the prestigious journal *Physical Review Letters*.

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CBRAM that lasts 10 years at 120°C

Despite its many advantages—it is fast, energy efficient, and easy to integrate—conductive-bridging RAM (CBRAM) technology has one weak spot: it can't store data at very high temperatures. That's why Leti researchers have teamed up with Altis Semiconductor to develop new materials and new electrolyte and electrode stacking methods. Thanks to these breakthroughs, the research partners have been able to create CBRAM that can store data at 120°C for up to ten years.

The scientists deposited a germanium disulfide electrolyte on a tungsten electrode and studied the effects of different antimony dopant concentrations in the electrolyte. In addition to the enhanced temperature resistance, the new CBRAM has an (almost) infallible memory and remarkable endurance—beyond 100,000 cycles.

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Day by day

The CEA-Magillem joint lab presents its research

Whereas most MINATEC joint labs tend to avoid the spotlight, the MINATEC-Magillem (a provider of electronic documentation systems) lab decided to hold a presentation day packed with exhibits, demonstrations, and panel discussions. Some 40 people from companies like STMicroelectronics, Schneider Electric, Thales, and Alstom attended the event to learn more about the lab's research.

These companies make systems-on-chips for telecommunications and multimedia applications, where the hardware is continually evolving—requiring labor-intensive, repetitive software adaptations. That's why they were happy to see that CEA-Magillem's work will help automate and speed the adaptation process, while making it more reliable.

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Day by day

Grenoble Institute of Technology gains ground

The new Grenoble Institute of Technology management team is continuing to implement the campus expansion plan established by the outgoing management team. As the largest higher education establishment in Grenoble's Presqu'île scientific district, the school aims to expand its presence in this research hub—of which MINATEC is a key player.

By September 2014 Phelma engineering school will get a new 500-seat auditorium facing the esplanade in front of the school, as well as space in a new 6,700 m² building that will also house an 800 m² technology transfer center. And by September 2015, ENSE³ will move out of its existing campus just outside of Grenoble and into new facilities in the Presqu'île scientific district. A new Grenoble Institute of Technology student center is also in the works, with housing, meeting areas, and recreational facilities.

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MINATEC brings home five Innovative Business Start-up awards

Five MINATEC companies and business ideas in 2012—up from three in 2011—were recognized in an award ceremony for innovative new businesses as part of the French government's program to finance start-ups.

In the Business Creation & Development category, the two MINATEC-based winning companies are Wavelens, a maker of optical parts for miniature cameras (founded by a Leti engineer) and Stiral, whose micro-mobile-wall heat exchangers were tested at Liten.

In the Business Ideas category, all three MINATEC-based winning projects employ technology developed at Leti. They are: Primo1D, which makes fabric threads incorporating electronic components; RPMK, which offers high-speed, wireless access to mass data storage; and Bee Secured, the most original project, which tracks bees using a system of specially-equipped hives in order to assess ecosystems.

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Phelma Junior Consultants kicks off new programs this autumn

For the first time this year, Phelma Junior Consultants' orientation program will be held over an activity-filled weekend at a chalet in the Vercors. During this weekend 20 new members will learn about the club's different roles and committees (like president, treasurer, secretary, membership development, and communications), so they can decide how they would like to contribute. Hands-on activities and role-playing are also on the agenda.

This year will also see the introduction of a new series of monthly evening events to start in October. Three Phelma alumni will talk about a particular issue important to students—like working in R&D or making a career change—during a series of three 20-minute interactive panel discussions in which students will have a chance to participate.

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Grenoble Institute of Technology students learn about international opportunities

This year engineering students at Grenoble Institute of Technology will get to learn about international opportunities at a new series of monthly events called *Les Rendez-Vous de l'International*. These events will include talks on timely topics like social networks, international recruitment, and "job dating," and give students an opportunity to share their own international experiences.

The first *Rendez-Vous* will be held on October 25, 2012 and will focus on topics like the second-year student exchange program from the points of view of both French students and international students from the countries discussed. The second will be held on November 23, 2012 and will be co-sponsored by Ubifrance, the French agency for international business development. This *Rendez-Vous* will focus on Ubifrance's international job experience program (*Volontariat International en Entreprise*).

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Grenoble proves fertile ground for Atrenta

US-based Atrenta—the world's fourth-leading provider of design software for the semiconductor industry—is actively expanding its French subsidiary based at MINATEC. This young business has already grown from four employees when it was created in early 2011 to 14 in June 2012, and plans to reach 20 by the end of the year.

This rapid business development is being driven by robust demand for Atrenta's software, which helps designers reduce circuits' energy consumption—a major benefit in today's marketplace—without affecting operation. Atrenta's success in France is also due to the synergies it has formed within Grenoble's innovation ecosystem. The company has set up a nine-person-strong joint laboratory with Leti to perform advanced R&D, appointed a research director from Verimag (a Joseph Fourier University, CNRS, and Grenoble Institute of Technology consortium) to its scientific evaluation committee, and hired a researcher from Joseph Fourier University.

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CEA supports business start-ups

Just a couple more weeks to go until we find out which ten or so projects have been selected for the First Step Challenge! This initiative, introduced by the CEA Tech scientific committee and CEA technology transfer department, aims to identify the most promising start-up ideas based on CEA Tech technology and to promote an entrepreneurial culture within the organization. The Challenge is open to all CEA Tech projects; winners get training and financing—up to €150,000—to help them transform their business plans into a viable company.

Team members of the projects selected for this inaugural year of the Challenge will attend two intensive seminars, and then present their business ideas to the jury, who will decide how much funding to grant each one. This trial-by-fire approach is designed to prepare budding entrepreneurs for the CEA business incubation process.

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Phelma releases 2012 admissions stats

The 2012 first-year cohort at Phelma—Grenoble Institute of Technology's engineering school—counts 353 students, with approximately half in each of the two core curricula: 174 students in Materials Engineering and Processes; and 179 students in Physics, Electronics, and Telecommunications. The percentage of students admitted based on prior degrees increased from 9% in 2011 to 11% in 2012, reflecting the school's policy of opening admissions to students not coming up through the traditional preparatory school channels. The number of students from the integrated preparatory programs remained steady at around 30.

The school fell around a hundred slots in the competitive entrance exam rankings, but this is simply a technical effect of the big Paris schools' decision to significantly increase the number of students they admit.

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Interview

Laetitia Rapenne,
LMGP:

“Our sample preparation training course is unique in France”

In November 2012, LMGP will offer its transmission electron microscopy (TEM) sample preparation course for the fourth time. What makes the course unique?

The training course covers various sample preparation techniques suitable for both solid and divided samples, such as: tripod mechanical polishing; ionic thinning; focused ion beam (FIB) milling; cleaved corner; nanoparticles in solution; and ultramicrotomy. Companies like Gatan, Escil, and Zeiss will lend equipment for use during the training course, which is open to research scientists, engineers, technicians, and PhD students. A team of eight microscopy specialists from France and Switzerland will facilitate the course. This is the only sample preparation course on offer in France.

Why is sample preparation training so important?

Nothing can replace training specifically on sample preparation, which provides valuable observation and hands-on practice. Sample preparation can produce a number of artifacts, from amorphization and strain hardening to dislocations and modification of the atomic structure. To get a clear image at the subnanometric scale—and avoid interpretation errors—it is important to reduce these artifacts to a minimum, and selecting the most appropriate sample preparation technique is crucial.

And how does Grenoble rank in terms of TEM sample preparation expertise?

The LMGP nanocharacterization platform boasts a highly-qualified staff that has earned international recognition for its expertise. People come from around the world to attend our courses. We generally get researchers from academia, but also corporate R&D professionals from companies like Hutchinson and LVMH.

<http://cnrsformation.cnrs-gif.fr/STAGES/StagesNx/012-VIII-07.html>

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The course will be held on November 12–16, 2012, and participants can opt to attend a separate course on ultramicrotomy on November 20–21, 2012.

Day by day

Grenoble Institute of Technology's MSc in Cognitive Sciences turns 20 this year

Grenoble Institute of Technology's MSc in Cognitive Sciences celebrated its 20th anniversary this summer. This year's cohort of 12 students was invited to attend the festivities, which were also attended by many of the program's 300 alumni and experts.

This one-year degree program is designed to prepare graduates for careers in research. It was founded in 1992 by a group of then-pioneering scientists and has since built a strong reputation in the field. Some 80 PhD candidates have come through the program, which is an anchor of Grenoble's Cognition Center (with 13 labs employing 200 researchers). The program is highly cross-disciplinary, covering signal processing, IT, psychology, and linguistics. All four of Grenoble's universities are partners in the program.

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Live from MINATEC

Enertecs to develop nickel-zinc batteries in Grenoble

Enertercs, a start-up that specializes in nickel-zinc batteries, has just set up shop in the MINATEC High-tech Building as part of a partnership with CEA-Liten. Enertercs is a subsidiary of Paris-based SCPS, which led a breakthrough in nickel-zinc batteries by successfully resolving the cycling problems inherent to these batteries. The company is now leveraging Liten's experience with battery production technology as it prepares to set up a semi-industrial manufacturing facility near Grenoble.

Enertecs should expand to around ten employees within a year. The company will also work with solar energy institute INES in Le Bourget. While nickel-zinc batteries are less powerful than lithium-ion batteries, they offer the advantages of being less costly and made from readily-available and recyclable materials.

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Alain Cottalorda elected Chairman of MINATEC Entreprises

MINATEC Entreprises, a majority government-owned company, elected a new Chairman at its September 7, 2012 Board of Directors meeting. Alain Cottalorda, 66 years old, will replace Geneviève Fioraso. Mr. Cottalorda is currently mayor of Bourgoin-Jallieu, a representative on the Isère General Council, and President of the Porte de l'Isère intermunicipal authority. He has also been Chairman of the Grenoble-Isère Economic Development Agency (AEPI) since 2008.

Mr. Cottalorda played a key role in the creation of MINATEC, chairing the MINATEC project committee from 2002 to 2006. He also spearheaded the METIS technology platform (in which MINATEC and CEA-Liten are the main research partners) for micro and nanotechnology for textile and paper applications.

Also at the September 7 Board meeting, Alain Ramberti was appointed General Manager of MINATEC Entreprises.

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Grenoble marks crystallography's centennial

In the run-up to 2014, the International Year of Crystallography, Grenoble's scientific community is gearing up to celebrate the 100th anniversary of modern crystallography. MINATEC and GIANT partners will play a key role in the festivities, which will include an exhibit on crystallography and its impact on our everyday lives at Grenoble's Grand'Place shopping mall during France's National Science Week.

Other notable events will include two talks by Dan Shechtman, winner of the 2011 Nobel Prize in Chemistry and the man behind the "discovery" of quasicrystals. These talks will be held on October 17 at the Weil Auditorium in Saint-Martin d'Hères and on October 22 at Grenoble's regional educational resource center. On November 13, Institute Laue-Langevin will host a day-long conference on the history of crystallography, from the discovery of diffraction to the latest advances in research.

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Live from MINATEC

MINATEC's Director to earn honorary doctorate from Quebec's INRS university

Quebec's INRS* university will grant MINATEC Director Jean-Charles Guibert an honorary doctorate degree at the Entretiens Jacques Cartier colloquium in Lyon on November 18, 2012. Prior to his tenure as Director of MINATEC, Mr. Guibert was an accomplished lithography researcher with some 20 patents to his name.

Mr. Guibert also made significant contributions to France's nanotechnology research collaboration with Quebec by championing joint research programs and scientific meetings. Not surprisingly, it was Mr. Guibert who got nanotechnology on the Entretiens Jacques Cartier program more than a decade ago. And last but not least, as a consultant to Quebec's provincial government, Mr. Guibert took part in a recent review of some 40 nanotechnology projects in Quebec.

*Institut national de la recherche scientifique

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LIST now featured at the MINATEC showroom

If you are not familiar with the research being done at Paris-based CEA-LIST, then stop by the MINATEC showroom to discover the research center's models, videos, and demos.

Several of the LIST-developed technologies being showcased stand out from the "products" familiar to Grenoble-based labs. Just a few examples include: augmented reality for sales reps; virtual reality; cobotics; automatic pedestrian detection; non-destructive control techniques; and troubleshooting for aeronautics and automotive cabling.

With the addition of LIST's latest advancements, the MINATEC showroom now covers the full range of research being conducted at the CEA's Technology Research Division.

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Horizons

2012 Science Fair to offer two days of educational activities

MINATEC is gearing up to host the 2012 Science Fair on October 12–13, 2012. This year's fair will offer something new by hosting the Expérimenta arts, science, and design fair. The first day of the Science Fair, Friday, will target high-school students and recent high-school grads enrolled in science and technology programs; the second day, Saturday, will be open to the general public. The many educational activities on offer are designed to help visitors understand how different technologies work and their potential applications, with a special focus on selected MINATEC research topics.

This year's program will also include a few new attractions: INAC will run booths on metals chemistry and supraconductivity; Leti will run a booth on human motion sensors; CIME Nanotech will give a photovoltaics workshop; IMEP-LAHC will give a hologram workshop; and Grenoble Institute of Technology-Phelma will lead a tour of a human-scaled camera.

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Leti presents 2011 research results in a series of five reports

If you have been wondering about Leti's research results for 2011, look no further! The lab has published a series of five reports (in English) available as downloads on the Leti website. Printed versions of the reports have been sent to Leti partners.

To design the reports, Leti looked at how top-tier universities communicate their research results. Each report is broken down into set of one-page data sheets on a particular research project, with a list of the year's major publications relevant to that area. The data sheets are grouped by topic into chapters. The reports round out Leti's more traditional annual activity report (also available in English on the Leti website).

Download the reports at: <http://www-leti.cea.fr/en/Discover-Leti/Documents3>

Horizons

Soon-to-be-hatched start-up LXRepair measures DNA repair activity

INAC is currently incubating a promising new start-up, LXRepair, that should be launched in 2013. LXRepair has developed a new multivariate method—backed by three patents—to measure enzyme activity in DNA repair.

LXRepair's technology targets two applications. First, to evaluate new treatments designed to interfere with DNA repair activity, like tumor-killing drugs, for example. Second, to monitor chemotherapy or radiotherapy patients during their treatment, since these treatments can interfere with DNA repair activity and cause patients to develop resistance or increased sensitivity. LXRepair's multivariate approach gives scientists broader and more detailed information than the single-variable methods currently available.

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Phelma signs new corporate partnerships

Over the past few months Grenoble Institute of Technology's engineering school, Phelma, has secured three new top-tier corporate partnerships: with Bull subsidiary Amesys (in June), Elsys Design (in July), and Safran (in September). These new partners will help train their future engineers by providing practitioner faculty and guest lecturers, offering student internships, and participating in events like Phelma Partners Day and Phelma Junior Consultants career orientation meetings. Partners can also opt to allocate their national apprenticeship tax contribution to the school.

The new partnerships are some of the first benefits of the school's corporate relations policy implemented two years ago. Phelma is currently in talks with around 20 other companies, with two new partnerships expected to be formed by year-end.

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Submit your project ideas for Phelma first-year engineering students

Phelma is counting on you to submit your ideas for student research projects and lab experiments! First-year students will complete their group projects during the second semester. Regardless of the field—physics, electronics, electrochemistry, robotics, or another science or technology—the projects will give students an opportunity to learn how to work as a team.

The potential range of subjects is vast. Past projects have included prototyping a portable trade fair booth, making artificial snow in conjunction with the glacier studies lab, producing a scientific video, and building a satellite that fits into a soda can (a CanSat). This fall Phelma will give students a choice of around 90 subjects, so all ideas are welcome!

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Horizons

Leti to showcase its technologies at R&D event *Rendez-vous Carnot*

Leti will be particularly well represented at this year's *Rendez-vous Carnot*, to be held in Lyon on October 3–4, 2012. This R&D event focusing on innovative products will feature 800 exhibitors and is expected to bring in some 2,000 professionals from a range of industries.

Most of the expected visitors work in industry or innovation. The event will include more than 8,000 pre-arranged one-to-one meetings and a slate of talks targeting specialists. Last year, Leti brought home 80 new leads, more than 50 of which turned into real-world business opportunities.

Leti has prepared 20 technology data sheets for the event, which is one of the cornerstones of the lab's full schedule of major international conferences that includes Semicon in San Francisco in July and Medica in Dusseldorf in November.

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Avenium Consulting produces competency database for KIC InnoEnergy

MINATEC-based Avenium Consulting, a subsidiary of CEA Investissement, has just finished compiling a massive Europe-wide database of competencies covering 87 manufacturing companies, research centers, and universities boasting a total of 250,000 patents and 100,000 publications. The project was commissioned by KIC InnoEnergy, a commercial business incorporated as a *Societas Europaea* that supports innovation in the field of renewable energy. The goal is to provide insight into the competencies—in six different technologies—of KIC InnoEnergy members as well as other companies.

Avenium Consulting was able to organize the massive amount of data gathered in just two months using its proprietary Innovation Index, which provides a qualitative assessment of a portfolio of patents, going beyond the mere number of patents to incorporate strategic factors as well.

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Phelma to hold first-ever intercultural workshop

Each year Grenoble Institute of Technology's engineering school, Phelma, hosts nearly 250 international students (200 undergrads and 50 grad students) from 50 different countries. On October 11, 2012 the school will hold its first-ever intercultural workshop at MINATEC. Open to French and international students alike, the workshop will give students an opportunity to meet and build bridges between cultures.

The workshop will open with an introductory talk before students break out into small, multinational groups for role-playing activities highlighting some of the differences in how we communicate across cultures. French students participating in the workshop can also opt to "sponsor" an international student after the event to build on the connections made and help create a lasting intercultural dynamic on campus.

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Agenda

October 3–4, Lyon

Rendez-vous Carnot, R&D event for businesses

<http://www.rdv-carnot.com/UK/index.html>

October 5, Maison MINATEC

The Research and Innovation Forum for young scientists and students from in and around Grenoble

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October 12–13, MINATEC

The 2011 Science Fair and the Expérimenta arts, science, and design fair

<http://www.atelier-arts-sciences.eu/index.php/experimenta.html>

October 15–17, MINATEC

ICPT 2012, the International Conference on Planarization and CMP Technology

<http://conference.vde.com/icpt-2012/Pages/ICPT2012.aspx>

October 18, Maison MINATEC Grenoble Institute of Technology-Phelma Partners Day

<http://phelma.grenoble-inp.fr/jdp/>

November 7–8, MINATEC N4E Industry-Academia Workshop – Nanophotonics for Energy

<http://n4e.eu/index.php/news-a-events/network-events/163-industrialworkshop2012>

November 12–16, LMGP Training on sample preparation for transmission electron microscopy

Participants may also register for additional training on ultramicrotomy on November 20–21

<http://cnrsformation.cnrs-gif.fr/STAGES/StagesNx/2012-VIII-07.html>

November 13–15, Maison MINATEC

Nanosafe 2012 international conference

<http://www.nanosafe.org/scripts/home/publigen/content/templates/show.asp?P=124&L=EN&SYNC=Y>

November 15-21, Lyon - Grenoble - Saint-Étienne - Lausanne

Entretiens Jacques Cartier

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MINA-NEWS >

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

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Editing: Benoît Playoust and Bénédicte Magne; Layout: Philippe Tur; Printing: Format Éditions, English translation: SFM Traduction