FROM RESEARCH TO INDUSTRY

cea tech

THE SHOWROOM

A WORD FROM

Transferring technology from research to industry… That is the mission of CEA Tech.

The range of activities of CEA Tech is particularly wide, extending from information technology to energy and software. So how can we demonstrate and provide an insight into the different technologies that we develop and which affect so many business sectors, including health and transport? How can we explain the technological processes that enable us to address the challenges of tomorrow? These are the questions that have led CEA Tech to establish a network of showrooms over the past few years. Within these emblematic locations, a series of demonstrators has been installed, each featuring an application that highlights the development potential of new functions. Our primary aim is to give each visitor an experience that relates CEA Tech technology to their everyday life through the applications and products that they use.

Illustrating the activities of our 4,500 researchers, our showrooms offer unparalleled access to the technologies, resources and technological platforms available from CEA Tech.

In this document, you will find a selection of demonstrators reflecting the many products that our partners have conceived and designed in collaboration with the CEA Tech teams.

Pascale Berruyer
Director
Services, Innovation
and Communications Division, CEA Tech

SOMMAIRE

THE NETWORK OF CEA TECH SHOWROOMS

THE GRENOBLE SHOWROOM

Opened in 2011, the Grenoble showroom provides the ideal environment to demonstrate the expertise of the CEA Tech research laboratories based in the Leti, List and Liten Institutes. It also encourages serendipity and stimulates innovation through a series of demonstrators accessible to all visitors, enabling them to relate the technologies involved to potential applications in their own fields of work. Finally, it is an exhibition space for products developed in collaboration with our industrial partners.

Each demonstrator highlights a specific theme, such as healthcare, habitat, space science, energy or transportation. Each demonstrator explains the history of the partnership concerned, together with the methods used to achieve the displayed result, the particular CEA Tech expertise employed, the R&D developed, the platforms implemented and the solutions designed. In addition to the object on display, there is a whole world of CEA Tech technological research to discover, together with our ability to work in collaboration with our industrial partners to bring them innovative solutions perfectly matched to their needs, whether they be a large industrial concern or a start-up company.

Over a hundred demonstrators are on display in the Grenoble showroom.

THE MOBILE SHOWROOM

In anticipation of the showrooms in the regional technology transfer platforms (PRTT), a mobile version has been designed based on the Grenoble showroom with the aim of bringing CEA Tech expertise closer to businesses in the regions, and to provide a presence at trade exhibitions.

The showroom contains approximately thirty demonstrators illustrating the work of CEA Tech. These demonstrators show the extent of the expertise of the 4500 researchers on our teams, reflecting our work in collaboration with industrial partners, that has led to the establishment of numerous start-ups company, and the high levels of industrial potential in the many PhD theses produced at CEA Tech.

On the road since July 2014, the mobile showroom has already visited two regions in which CEA Tech has a presence, and been displayed at many trade shows.

WE WERE THERE:

- **SEPTEMBER 16-19, 2014:**
Innovation Connected Show, Toulouse

OCTOBER 7-9, 2014:
SEMICON, Grenoble

- **DECEMBER 1-7, 2014:**
Osons la France, Paris

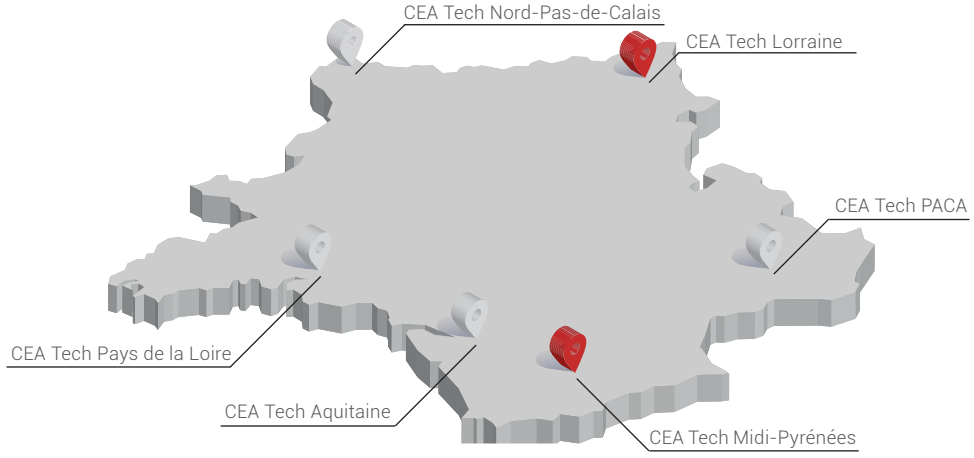
- **DECEMBER 8, 2014 – JANUARY 16, 2015:**
Metz (CEA Tech Lorraine)

THE REGIONAL SHOWROOMS

We are proud to announce that two new showrooms have been created in the first quarter of 2015 in the following regions:

- Midi Pyrénées (Toulouse)
- Lorraine (Metz)

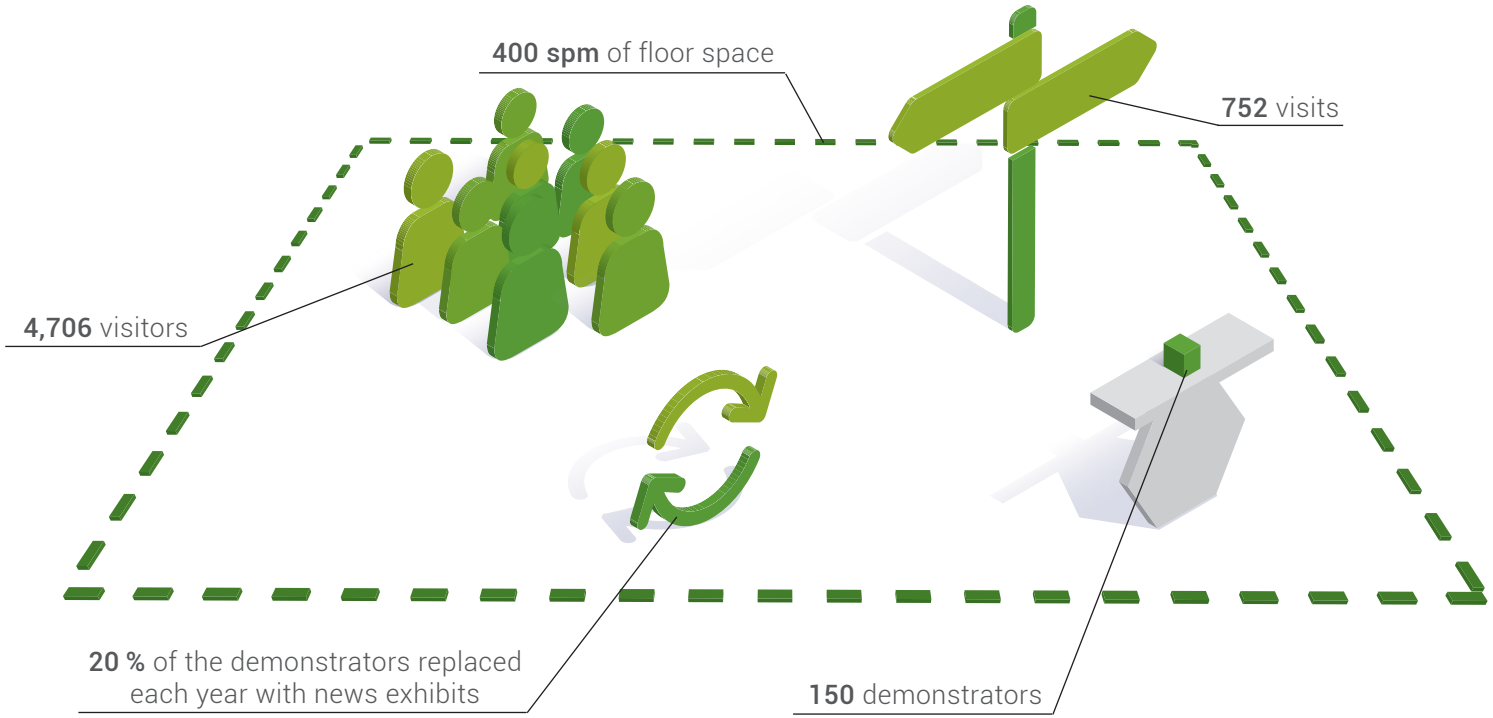
More showrooms opening soon!



Most of the demonstrators in our showrooms bear witness to the success of our collaborations with industrial partners.

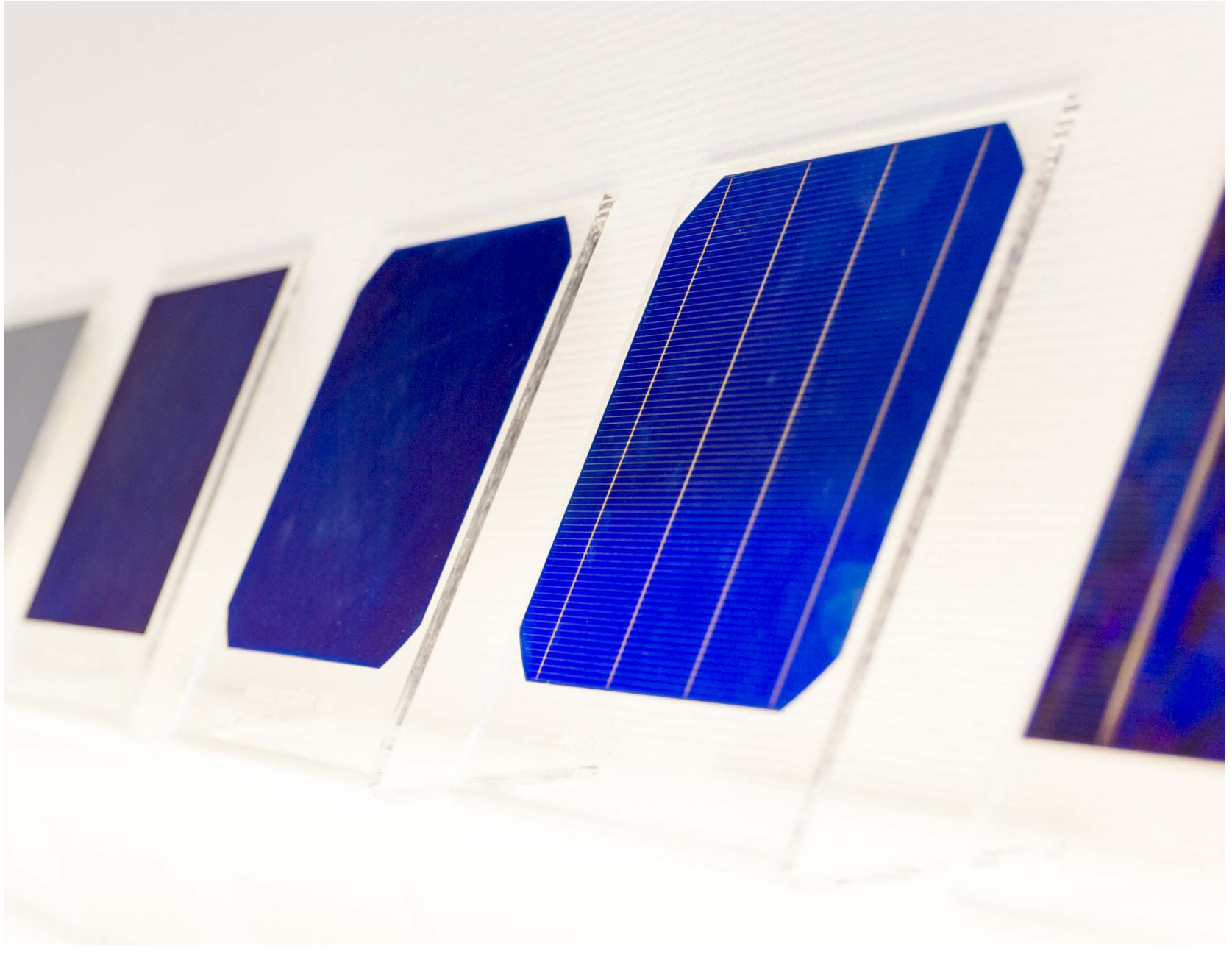
KEY FIGURES

KEY FIGURES FOR THE GRENOBLE SHOWROOM IN 2014



DEMONSTRATORS AND EXPERTISE

There are currently about a hundred demonstrators on display in the Grenoble showroom, and approximately thirty in the regional and mobile showrooms.



ELECTRICITY GENERATION

> The solar energy story

Putting the spotlight on solar power generation

This set of display panels describes the various stages in the transformation of raw silicon into a photovoltaic solar panel. These include the refining of the silicon, crystallization, slicing, processing the cells, and assembling the solar panels. All these steps are being researched in depth at CEA Tech (Liten). On the INES* site at Bourget-du-Lac, our research teams are working on photovoltaic and thermal solar energy systems, together with their integration into buildings. All the technologies under development can be tested there under real-world conditions.

The work being carried out at INES aims to reduce the manufacturing cost of the photovoltaic and thermal solar components by working on the materials used, and to improve the efficiency of the various technological building blocks. Work is also being undertaken with the objective of developing optimized energy management and storage solutions in order to smooth out variations in the generation of photovoltaic electricity and facilitate the integration of solar systems into the power distribution grid.

This research contributes to the drive to reduce the French carbon footprint and dependence on fossil fuels.

**The French National Solar Energy Institute*

ELECTRICITY STORAGE

> Mini-battery

Small – but full of energy!

Energy storage is a major technological challenge, and one that is being addressed in depth by CEA Tech. The Liten Institute has developed a high level of expertise in the design of lithium batteries. Lithium-ion technology is particularly well-suited to on-board energy storage systems as the energy density is around twice that of any other technology. In automotive applications, this translates into increased range, smaller size, less weight, rapid charging and a very low self-discharge rate. However, CEA Tech is also researching alternatives to lithium-ion technology with the aim of achieving further improvements in range, power and safety.

In order to provide an even better response to the problems facing manufacturers, CEA Tech has established a dedicated battery development platform offering industrial companies access to the expertise of its research teams involving a broad spectrum of battery technologies.

The platform operates under conditions approaching those of a manufacturing plant, with facilities including from the production of new materials, through the design and manufacture of batteries to final performance testing.

This facility is unique in Europe, enabling CEA Tech to develop batteries capable of providing the performance needed by its partners, addressing both niche markets and mass markets such as electric vehicles and medical devices.


P3

HEALTH

> Patvax

Improving the control of processes

This portable micro-sensor is used to check quality during the design of new drugs and vaccines. It provides a real-time analysis of many parameters of a solution, including its homogeneity, by making simultaneous conductometry and accelerometry measurements.

The design of this system is based on technologies developed by CEA Tech (Leti), including a portable conductivity micro-sensor capable of carrying out both conductometry and accelerometry measurements.

The aim of this micro-sensor is to help pharmaceutical companies comply with the Process Analytical Technology (PAT) legislation intended to strengthen process quality. The device can also be used in other inspection procedures in fields such as the food industry, chemistry and biotechnology.

ELECTRIC MOBILITY

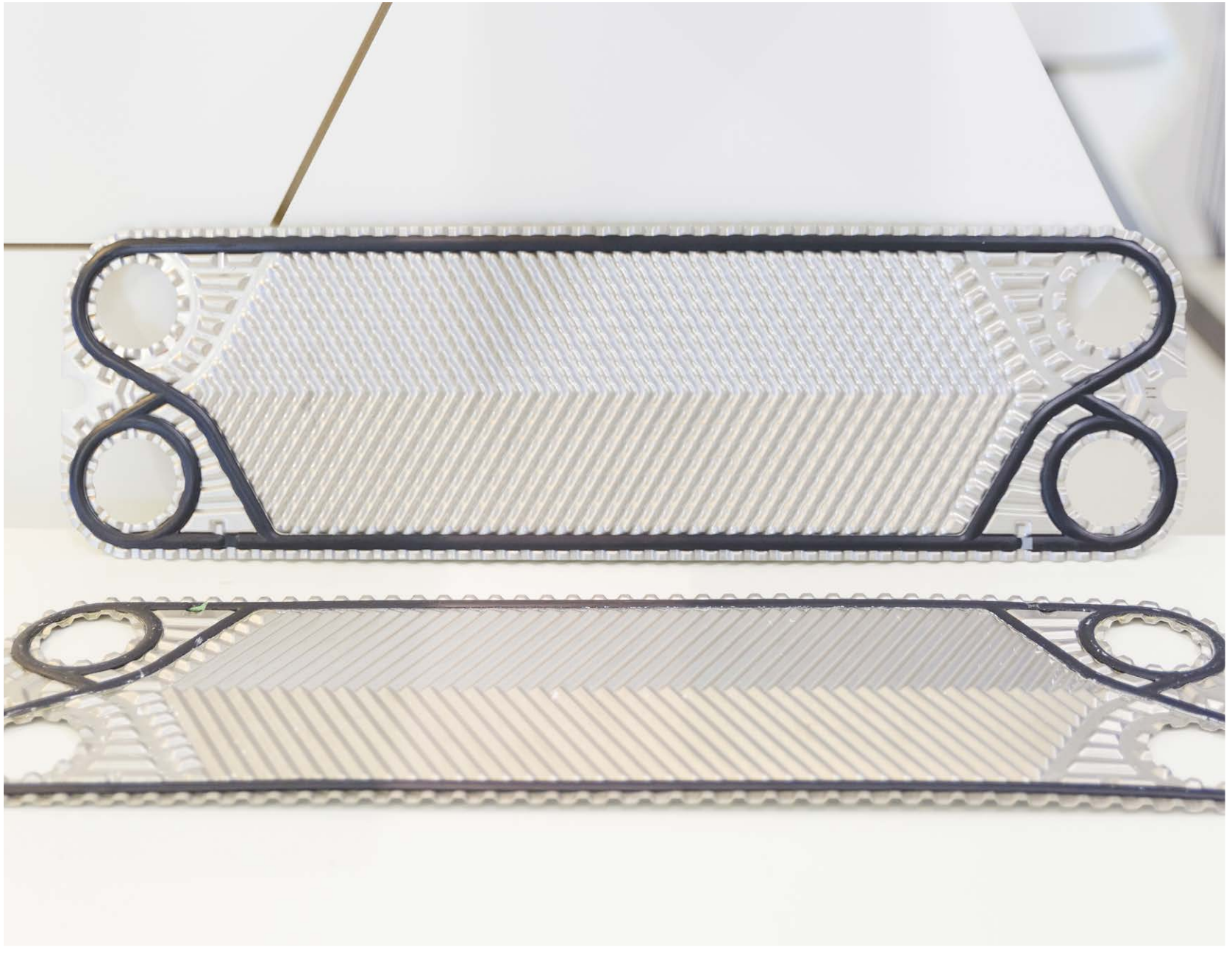
> Electric vehicles

Improving battery performance

CEA Tech has been carrying R&D work on electric vehicles for many years. In responding to the major challenges posed by zero-emission vehicles, experts from the three CEA Tech Institutes (Leti, List and Liten) have come together to pool their expertise in the following three complementary fields:

- Energy storage, including the choice of lithium – iron - phosphate electrochemistry for its safety, longevity and cost, and the design and optimized assembly of battery pack modules taking account of all mechanical and thermal aspects.
- Optimization of the electrical and electronic battery management system (BMS) architecture.
- The development of a dedicated human – machine interface for electric vehicles.

All this expertise is demonstrated by the Renault Twizy displayed in the showroom.



HEAT GENERATION AND STORAGE

> Heat exchangers

Warmth and comfort!

The continuing development of more energy efficient and less environmentally damaging processes is an essential factor in combating global warming due to greenhouse gasses. This is especially the case in an industry sector that accounts for over 20% of all greenhouse gas emissions.

In this context, CEA Tech has acquired over twenty years of cutting-edge experience in the field of heat exchangers. Particular areas of expertise include thermodynamics, the modeling of heat transfers, and the design, manufacture and testing of innovative heat exchanger geometries designed to improve both their thermal and mechanical properties.

CEA Tech is working on the optimization of the assembly process, including brazing (assembling metal parts using an intermediate layer of liquid metal) which is better at resisting heat than using adhesives, and diffusion welding assisted by hot isostatic compaction, a process that can be used to join materials that are considered to be unweldable.

CEA Tech has access to a number of experimental platforms that are used to characterize the performance of the heat exchangers under a wide range of operating conditions.
With such expertise, CEA Tech is able to develop high performance heat exchangers capable of operating under severe environmental conditions in terms of temperature, pressure, and corrosion.

RELIABILITY AND DIAGNOSTICS
> Wiring diagnostics

Stay connected!

This work relates to the wiring harness in a motor vehicle. Extensive wiring systems are also found elsewhere, in the aerospace industry for example, and their size and complexity makes reliability, and that of their connectors, a major challenge.

Making use of expertise in the List Institute, CEA Tech has investigated the problems of maintaining wiring networks with the aim of developing technologies to detect, locate and characterize wiring faults.

The technology under development is based on reflectometry, using a probe signal in a similar manner to radar. An electromagnetic wave is injected into the wiring network. When the wave encounters a change in characteristics (an open circuit or short circuit, etc.), part of its energy is reflected, while the remainder continues to propagate through the branches of the wiring. The reflected signal can be analyzed to detect, locate and characterize the fault.

This technology has been transferred to a start-up company, WinMS, which is developing and marketing real-time diagnostic tools for the aerospace industry, together with a system to monitor cable infrastructure as a means of combating cable theft.

HYDROGEN TECHNOLOGIES

> Hydrogen

An energy vector for tomorrow

This demonstrator highlights the expertise of CEA Tech across the range of hydrogen technologies. Economically and ecologically, hydrogen is currently one of the most promising energy vector technologies. Hydrogen burns cleanly, generating only water vapor, but it has to be manufactured as it does not occur naturally. Bringing together its expertise in materials, electrochemistry and energy engineering, CEA Tech is a world leader in this technology.

It has a presence at each step of the value chain, from production, through storage, to the fuel cells used to convert hydrogen into electricity. Production research is focused on the electrolysis of water vapor at high temperatures (700 °C to 800 °C), with high energy efficiency.

Research into the conversion of hydrogen into electricity is concentrated on two types of fuel cell; low temperature polymer electrolyte membrane fuel cells (PEMFC) intended for automobile and static applications, and high temperature solid oxide fuel cells (SOFC), primarily for static applications. This type of cell can also be fueled by natural gas or biogas.

Finally, low pressure hydrogen storage systems based on solid hydrides are also being developed for static and heavy transport applications. Each of these fields of research presents its own challenges, including those of yield optimization, durability, robustness, safety and cost.

CEA Tech experts are meeting these challenges head-on by means of their Hydrogen Production and Storage Platform, a facility used to develop and qualify large-scale demonstrators in collaboration with industrial partners.

BIOMASS

> Biomass

Developing second-generation biofuels

The biomass platform, an R&D center unique in France, focused on generating energy from waste. The types of biomass are extremely varied, including wood, straw, tires, sewage sludge, black liquor, seaweed and domestic waste. No less diverse its diverse uses, including the generation of electricity and heat, and the production of synthetic natural gas and other useful chemical molecules. This demonstrator highlights technologies developed for three key stages in the transformation of biomass into useful biogas:

- The preparation of the biomass, including all the operations needed to prepare the biomass for the gasifier.
- The thermo-chemical gasification or conversion process, resulting in a gas that can then be used to generate electricity or heat, or to produce synthetic natural gas or other fuels, or chemical molecules for use in green chemistry.
- Cleaning: The gas produced during the gasification process contains two useful constituents, carbon monoxide and hydrogen, along with a number of contaminants including tar, inorganic contaminants and particles. All must be removed before the gas can be used to synthesize fuels.

CEA Tech has expertise in all stages of biomass and waste processing. This integrated approach enables research to be carried out across entire technologies, applying to all types of biomass and waste. Therefore, CEA Tech can address technological difficulties with a systematic approach. CEA Tech is thus capable of designing a transformation process that is optimized to suit the nature of the resource and the final application.

CEA Tech has created the GENEPI platform (Gasification Equipment for New Energy dedicated to a Platform of Innovation) that has been used to verify our research results on an industrial scale in partnership with the ANR, Investissement d'Avenir, CIRAD (agronomic research for development), and the Mines Albi-Carmaux. The semi-industrial nature of the systems used in this platform make it unique in Europe. It includes a preparation unit for drying grinding and heating the raw material, together with a fluidized bed gasification reactor.


DIOSMINE
DIOSMINE
MYLAN
PIASCLEDINE 300
EXPANSCIENCE
specimen
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50
200
500
EURO

ADVANCED MATERIALS

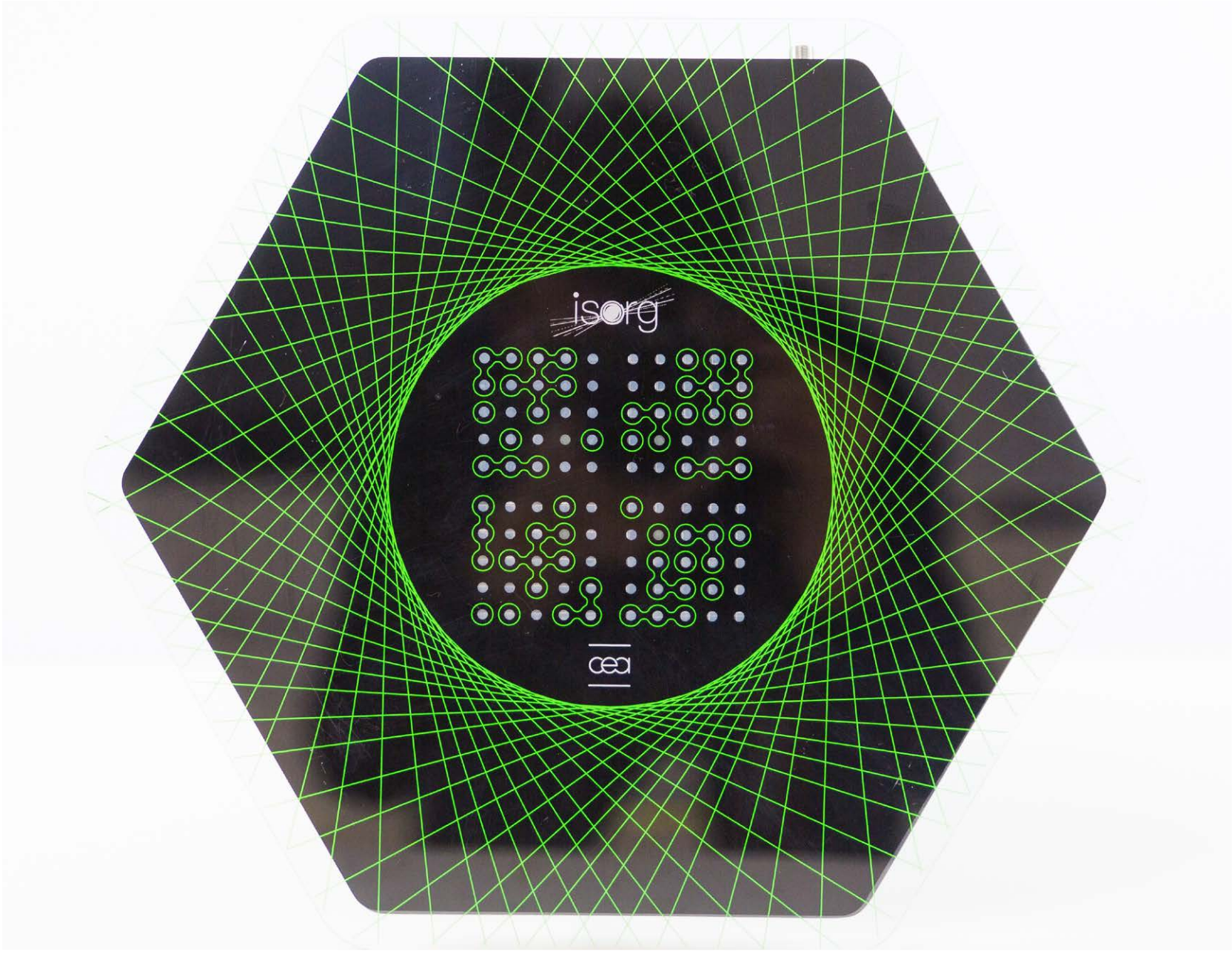
> Nano-marking

Beating the counterfeiters

Between 5 and 10% of all world trade consists of counterfeit goods, and the problem affects all business sectors. In addressing this problem, CEA Tech has developed a range of innovative marking solutions based on nanotechnology, fluorescence and optoelectronics. CEA Tech is working with the start-up company Naomarq with the aim of developing a range of markers suitable for industrial use.

CEA Tech expertise covers the entire value chain from production of the base materials to product integration, including the development of multi-scale micro and nano-tracers. CEA Tech has the capability to develop unique, robust and durable visible and invisible markers that do not affect the properties of the substrate on which they are placed. They may be applied to the surface or included in the body of the material.

A specially developed portable spectrometer provides instant and reliable readout. The embedded microprocessor adjusts the measuring conditions to the type of material to be detected and is capable of detecting complex optical codes.


isorg
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ELECTRONICS FOR LARGE SURFACES

> Isorg, printed electronics

A new generation of human-machine interfaces

This non-contact interactive tablet is called the Magic Pad. It uses photodetectors printed onto a plastic substrate to create a revolutionary human-machine interface. Isorg (from Image Sensor Organic) is a pioneer in printed organic electronics for photodetectors and large-scale image sensors using a range of breakthrough technologies.

These developments have been supported by the CEA Tech PICTIC platform, a resource capable of transforming plastics, textiles, paper and glass into an intelligent surface that can interact with its surrounding environment. This specialized R&D platform brings together a range of printing processes, including silk-screen, inkjet, photogravure, flexography and slot-die coating.

The platform also provides a collection of characterization, assembly and encapsulation systems, making it unique in Europe. Potential applications for this new process also include intelligent lighting, interactive screens and environmental monitoring.

CABINET OF CURIOSITIES

> The EZ3kiel ball

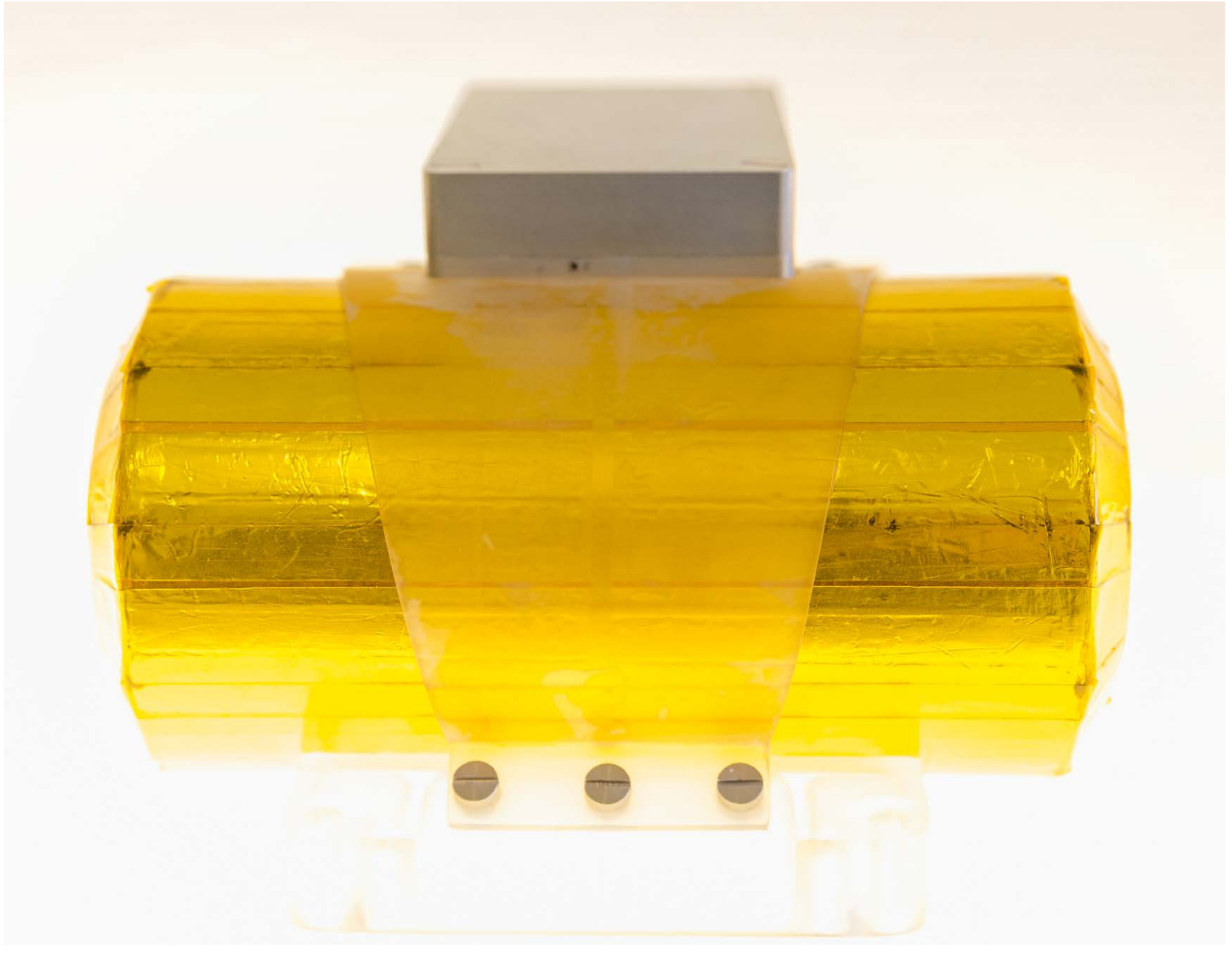
Science becomes art

CEA Tech research has collaborated with the musicians of the Ez3kiel group at the Atelier Arts Sciences*, resulting in the creation of a number of installations combining traditional objects with state-of-the-art technology.

This PVC ball is one of the results of this collaboration. It provides a unique method of enabling the audience to interact with the artists on stage. The ball is fitted with a number of MEMS sensors that detect the acceleration and trajectory of the ball, together with a radio transmitter to send the data to a system that generates sounds and light sequences reflecting the movements of the ball and the impacts applied to it by the audience.

This interaction between researchers and artists offers a new point of view relating to the use of the technologies developed at CEA Tech, taking them out of the laboratory to find new applications and giving the researchers a new perspective on their work.

**The Atelier Arts Sciences is a joint laboratory used by both scientists and artists and founded by the Hexagone Scène Nationale Arts Sciences de Meylan and CEA Tech in 2007.*



SPACE SCIENCE

> Helium magnetometer

Hello Houston?

The Leti Institute has collaborated with ESA and CNES for several decades on a series of space projects involving both technological research and the construction of entire instruments for use in space missions launched at the end of 2013.

The aim of one of these, the Swarm mission, is to gain a better understanding of the behavior of the Earth by studying its magnetic field in detail. The helium magnetometers on board the three orbiting satellites that comprise this mission were developed by Leti. They are capable of providing a detailed mapping of the magnetic field and identifying the contributions of each of the sources of that field; the magnetosphere, the ionosphere, the oceans, the Earth's core, the mantle, and the Earth's crust.

The steadily improving performance of this new generation of instruments provides far more detailed measurements that the nuclear magnetic resonance sensors used on the earlier Oersted and Champ missions. The data being collected will provide scientists with a better understanding of changes to the Earth's magnetic field, enabling them to predict future changes in a phenomenon critical to life on the planet.

INFRASTRUCTURE AND MATERIALS

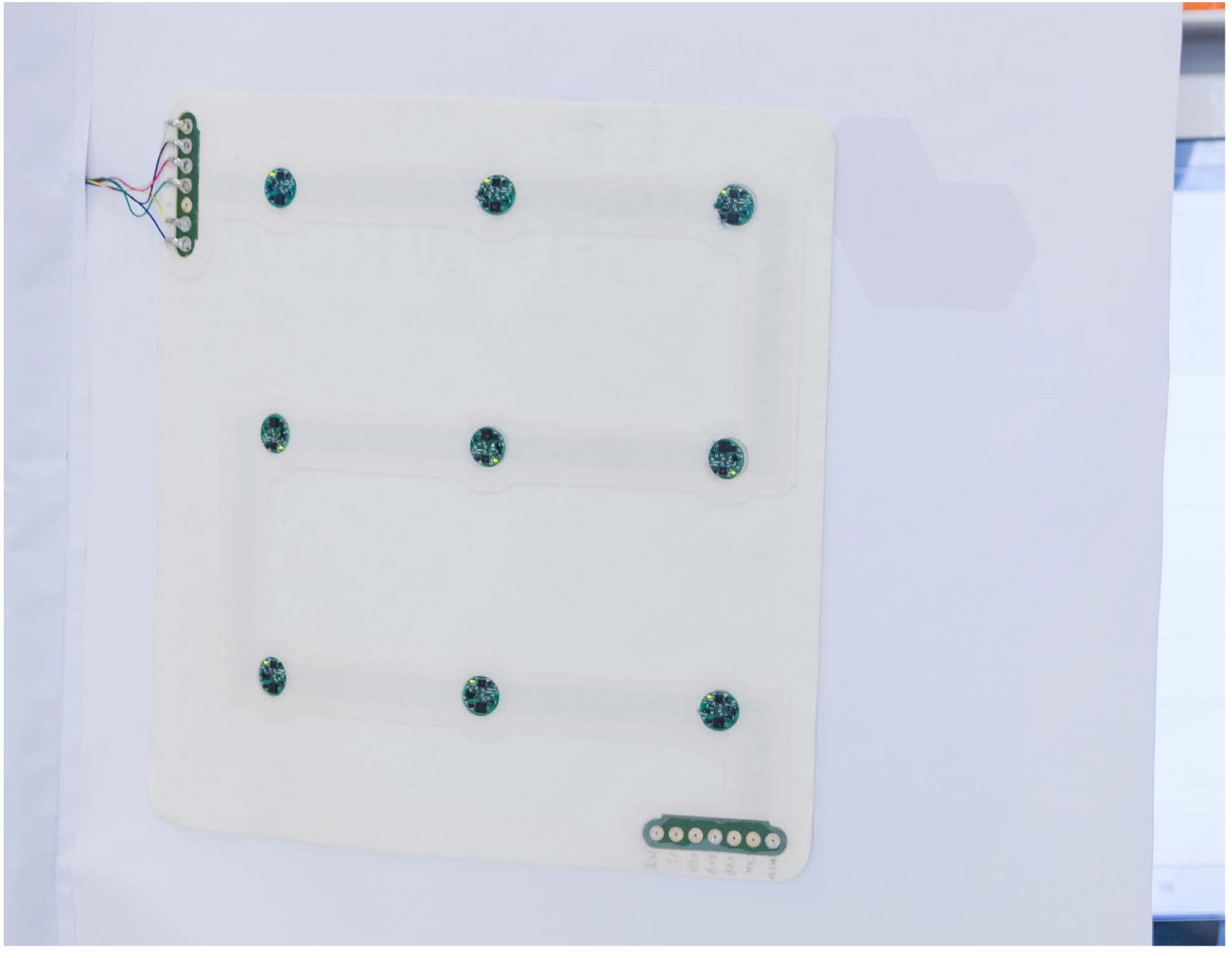
> Micro-technologies on wafers

The Sushi Bar

This rotating turntable displays a sample of the many micro-technologies developed by CEA Tech for application to silicon wafers. Each wafer consists of many different types of advanced integrated circuits and micro-systems on a variety of substrates. They illustrate some of the main CEA Tech research topics, including 3D integration, embedded memories, MEMS and NEMS, imagers, silicon photo devices, and power components.

CEA Tech is capable of processing 200 mm and 300 mm wafers in its 7000 spm nano-electronics and micro and nano-systems facility.

This facility enables CEA Tech to offer its industrial partners access to the latest technologies in response to their requirements.



INSTRUMENTED MATERIALS

> Morphoshape

Design me a surface

Morphoshape makes use of a range of technologies capable of being applied to a material such as a fabric, instrumenting the surface in order to recreate a virtual version of its actual form to a high degree of accuracy. This instrument for measuring the shapes of surfaces in space is a technology developed by Leti at CEA Tech on the basis of a set of accelerometers and magnetometers.

It consists of a set of micro-sensors distributed over a surface, each feeding data to a reconstruction algorithm. Monitoring a surface in this way can be particularly advantageous in the field of predictive maintenance when applied to risers, sails and building infrastructures.

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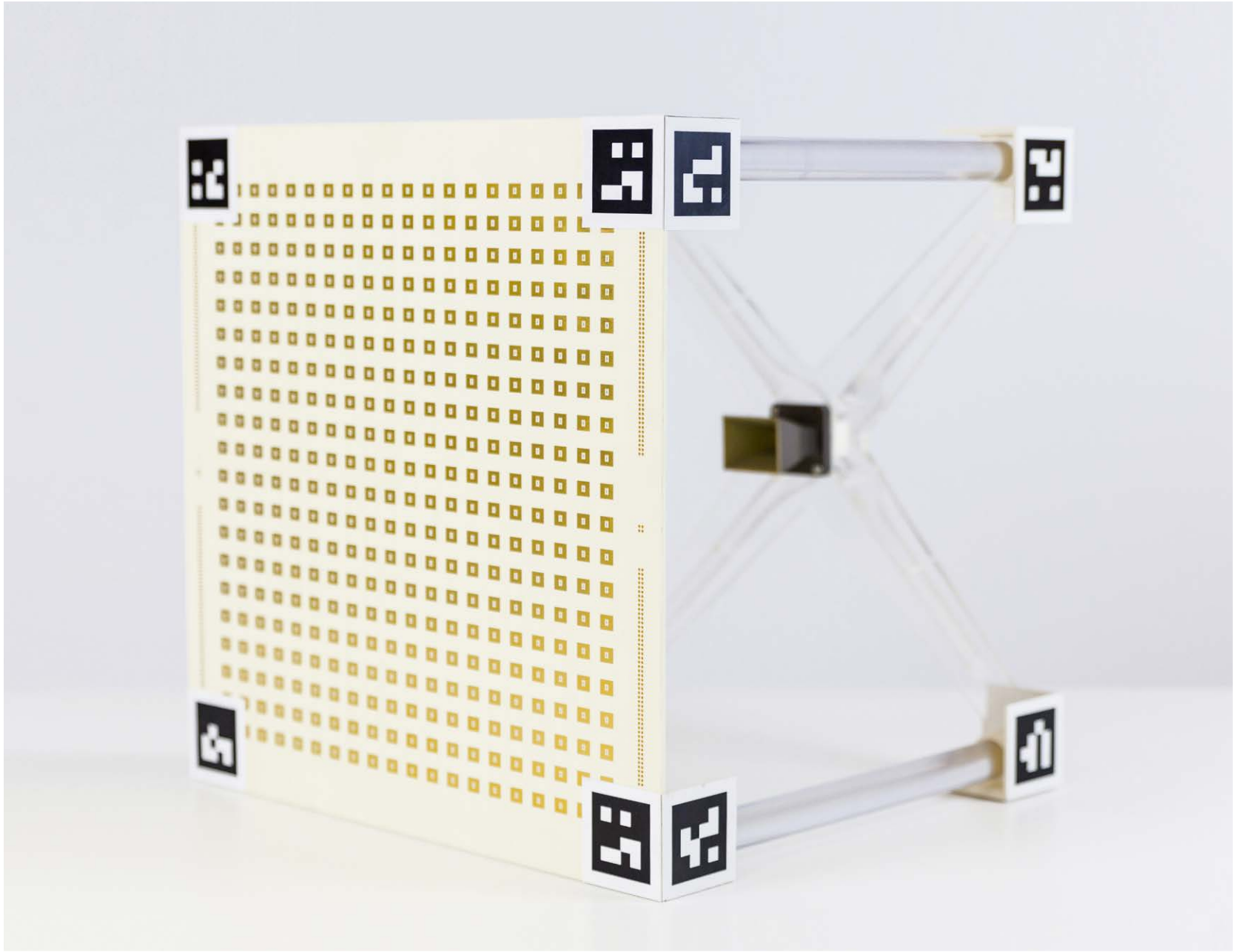

GREEN TELECOMS

> Reconfigurable antennas

Receiving you loud and clear

Developed by CEA Tech research teams, this antenna demonstrates Leti's institute's expertise in the field of electromagnetic radiation. Developed by a succession of PhD students, this antenna can easily be reconfigured to maximize transmission in any given direction. Incorporating mechanical movements controlled by electrical signals, the antenna can be used with any type of radio transmission system to automatically align itself in the optimal direction.

In the face of an increasing demand for data transmission at high data rates, this reconfigurable antenna provides an ideal solution to a specific industrial requirement while remaining compatible with existing systems.

This solution benefits from a high potential for innovation in new antenna applications including transport and mobility.


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IMAGERS

> Infrared sensors

The temperature in images

Until about 15 years ago, all infrared detectors were based on photodiodes and required cooling to around – 200 °C, making them very expensive.

Since then, CEA Tech has been working on bolometer technologies capable of operating at ambient temperature. A bolometer transforms infrared radiation into heat which is then converted into an electrical signal. Current work is focused on miniaturization (micro-bolometers) and the transfer of the technology to mass-market products. For the past ten years, this work has been carried out in partnership with Ulis, a spin-off company from the Leti Institute.

There are many applications for 'room temperature' infrared imagers. These include safety (night driving and the detection of gas leaks), energy saving (insulation and occupancy detection for lighting or heating), health (monitoring hospital treatment at home and detection of infected travelers at airports), and the preventive maintenance of overheating components.

HUMAN MACHINE INTERFACES

> Augmented reality

I can't believe what I'm seeing

This demonstrator highlights the expertise of the List Institute research teams in the field of augmented reality. The wearable device displayed here brings together two aspects of key expertise in this field. The first consists of the real-time accurate superimposition of virtual information onto a real image (the object being filmed), regardless of the position of the observer relative to that object.

The second relates to the use of high performance algorithms in systems with relatively low processing power, such as tablets. Augmented reality is currently finding many applications in fields as diverse as the factory of the future, training, computer-aided maintenance, and sales.

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CONTACT

showroomceatech@cea.fr