ACARAC 2023

Serving Industry for Trust

10e édition

Discover the Unique and Complementary Characterisation Offer Available from the French Institutes of Technology

NANOELEC. Platform for Advanced Characterisation | PAC-G

IRT SAINT EXUPÉRY

RAILENIUM RAIL RESEARCH & INNOVATION

IPVF

SuperGrid Institute Shaping power transmission

ines.2s SOLUTIONS SOLAIRES

With the support of

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STREAMLINE

FRANCE 2030

The expertise in characterisation of the Technological Research Institutes (IRT) and the Institutes for Energy Transition (ITE), serving trust for industries: System reliability, failure analysis, and material properties.

Characterisation to Support Technological Engineering

Characterisation encompasses a wide range of processes through which the structure and properties of materials, components, or systems are probed, imaged, and quantified. It allows us to understand the underlying phenomena and construct predictive models in terms of reliability, evolution, and aging. Consequently, characterisation is a fundamental process fully integrated into the development of materials and the resulting products. Without it, any scientific and technical understanding of a technological engineering approach remains out of reach.

Advanced and Diverse Techniques

Characterisation contributes to adapting the processes of handling, transport, treatment, and implementation of materials and components to achieve the desired performance for specific applications. It focuses on the fine-scale organisation of the object under study (crystalline or amorphous structure, physico-chemical composition, defects) as well as its macroscopic and functional properties (mechanical strength, electrical response, surface condition, etc.).

It involves the use of techniques ranging from imaging to spectroscopy across various electromagnetic spectrum domains, as well as mechanical, physico-chemical, and electromagnetic stress-inducing devices, particularly for failure analysis. The preparation and conditioning of study samples, as well as data consolidation and interpretation, form a significant part of any characterisation work.

Trust and Characterisation : Inseparable Factors

The characterisation community involves industrial stakeholders as end users, equipment manufacturers (both large enterprises and SMEs), research institutions, technological organisations, and higher education institutions.

For research and development, characterisation data guide researchers and engineers in optimising the concepts they deploy and associated implementation conditions. For the industry, it provides data to ensure proper operation and failure analysis, environmental footprint control, and the service life of final products. It contributes to the reliability of industrial processes, trustworthiness, and technological credibility that must be attributed to them.

A Shared Challenge

In practice, characterisation is essential and fully integrated into technological developments led by the IRT and ITE institutes within the FIT association.

The Carac'2023 symposium aims to showcase the potential of FIT institutes in terms of characterisation, both in terms of platform performance and team excellence.

Several topics will be documented and discussed through numerous practical examples, both from the materials and integrated systems perspectives. Two questions will be debated: one on the effective utilisation of characterisation data, and the other on their implementation in a sustainable and responsible development approach.

SOMMAIRE

SOMMAIRE

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Add the hashtag **#CARAC2023** to your posts

For more information on today's event, visit

IRT NANOELEC

NANOELEC.
Platform for Advanced Characterisation | PAC-G

Presentation

The IRT Nanoelec offers through its Platform for Advanced Characterisation - Grenoble (PAC-G), a range of **services**, from simple consulting to **sample characterisation** and data analysis.

It provides access to large-scale research infrastructures such as the **synchrotron** or **neutron sources**.

OUR PARTNERS

The PAC-G brings together in a **consortium** CEA-Leti, ESRF, ILL, and LPSC at the scientific polygon of **Grenoble**.

FOR WHICH INDUSTRY?

The **micro**- and **nano-electronics** industry.

OUR ASSETS

The PAC-G offers a **cost-effective**, **fast**, and **tailor-made** service for the industry.

Nanoelec PAC-G provides a single point of access to large-scale facilities such as synchrotron and neutron-based sources through a cost-effective and rapid service tailored to innovation in electronics. © P.Jayet/CEA

IMAGING & FAILURE ANALYSIS

• **Market**: Semiconductors, electronics, automotive, materials, aerospace, and defense.

• **Resolved issue:** Defect visualisation, material analysis, performance evaluation, nanometric characterisation.

• **Sample**: Microcomponents, electronic devices, various materials.

• **Description**: This offer provides high-resolution imaging techniques to examine internal structures and defects in samples, offering an in-depth insight into characteristics and sources of failure.

• **Unique Advantage**s: Non-destructive analysis, with ultimate spatial resolution, over broad regions of interest; ability to distinguish different materials; capability to perform real-time, in situ analysis under operational conditions.

1 CEA-Leti (The French Alternative Energies and Atomic Energy Commission), ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), and LPSC-CNRS (Laboratory of Subatomic Physics and Cosmology).

IRT NANOELEC

NANOELEC.
Platform for Advanced Characterisation | PAC-G

Irradiation

• **Market**: Aerospace, microelectronics, R&D.

• **Resolved Issue:** Evaluation of individual effects, controlled defect injection, characterisation of focused pulsed synchrotron X-rays.

• **Sample**: Electronic components, materials, various objects.

• **Description** : Provides irradiation solutions to assess the resistance of materials and electronic components to radiation, simulating extreme environments and enabling reliability and performance studies.

• **Unique Advantages**: Ability to perform focused fault injection on buried structures, with sub-micrometric spatial resolution and depths unattainable with traditional sources; possibility of pulsed or continuous beam delivery.

SRAM commercial memory set-up on a connecting PCB ready for irradiation at the ILL, the European neutron source for research, based in Grenoble ©Cern

Physical & Chemical Characterisation

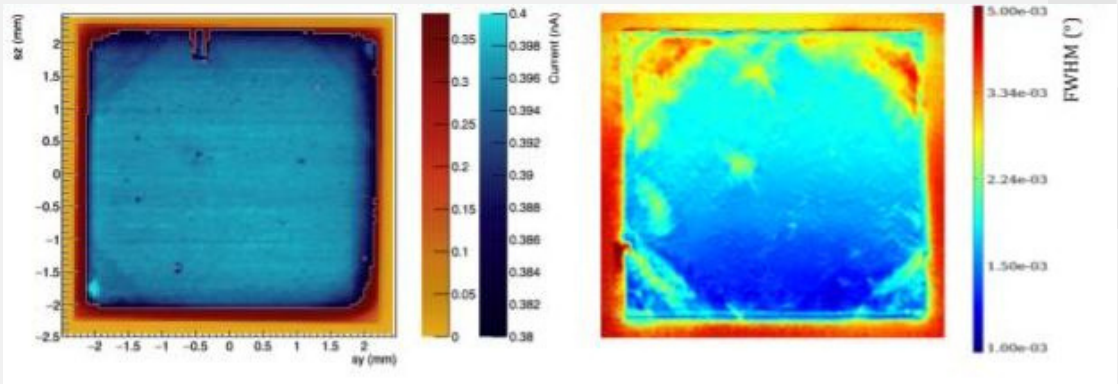
• **Market**: Semiconductors, materials, microelectronics, manufacturing, R&D, metallurgy.

• **Resolved Issue:** Defect visualisation, multi-level & nanometric material characterisation, analysis of processes and structures, material and application development.

• **Sample**: Generally in the micrometers to millimeters range. Finished object, material...

• **Description** : Provides advanced characterisation techniques to analyse finished objects or materials, delivering precise information about their structure, properties, and defects.

• **Unique Advantages**: Ability to provide non-destructive measurements of residual stress with ultimate precision; ability to provide structural information on very thin layers; ability to provide chemical information with ultimate detection limit



Characterization becomes correlative: Correlations between electronic properties and structure of diamond samples established at the ESRF, the world's brightest synchrotron, based in Grenoble © ESRF

IRT SAINT EXUPERY

Presentation

Since 2013, the IRT Saint Exupéry has been building a coherent set of technical resources - manufacturing and advanced characterization test benches - and cutting-edge skills - to enable companies to meet the challenges of the industry of the future.

We provide optimized materials and process solutions with a focus on (multi)functionalization and frugality in terms of the materials used, as well as durability and repairability.

Similarly, our electrical and electronics activities are helping to remove the technical barriers to the accelerated implementation of electrical technologies in the context of mobility, in order to also contribute to the decarbonization of transport.

You will find hereafter several characterization techniques and test benches available for Electrical & electronic characterization (for complete overview, cf. link “OUR ASSETS”)

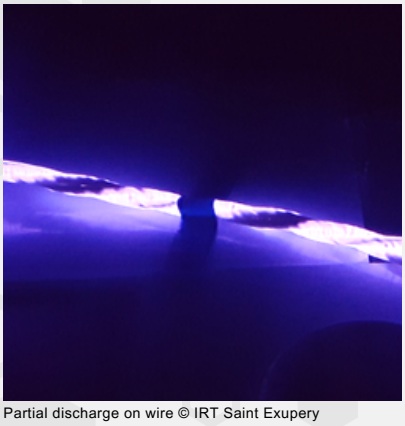
FOR WHICH INDUSTRY?

Aeronautics, Space, Defence and synergetic markets

OUR ASSETS

https://www.irt-saintexupery.com/wp-content/uploads/Platform-offer.pdf

Electrical Arc platform © IRT Saint Exupery



Partial discharge on wire © IRT Saint Exupery

Electrical arcs & partial discharges characterization

• **Market**: Electrical systems, electronics, automotive, materials, aerospace, and defence.
• **Resolved issue:** phenomena understanding under representative aircraft conditions, trade off between protection solution, etc…
• **Sample**: Equipment, component, electronic devices, various protection shield materials and harnesses
• **Description**: Capability to generate electric arcing with various triggering conditions : High voltage , Vibration, FOD , Chafing, slicing of cables, etc). AC / DC power supplies, current & voltage measurement, etc.
• **Unique Advantages**: The platform also features an aircraft electrical heart and loads, which can simulate several faulty arc signals from onboard equipment. This electrical heart features power contactors, battery… Concerning ageing under partial discharges constraint with a large sample amount: implementation of an in-situ monitoring represents thousands of measurements on several hundreds of samples. Carrying out these measurements manually would be too repetitive and thus we designed an automation system for the measurements.

Dielectric characterization & Ageing of electrical insulation

• **Market**: Electrical systems, electronics, automotive, aerospace, and defence.

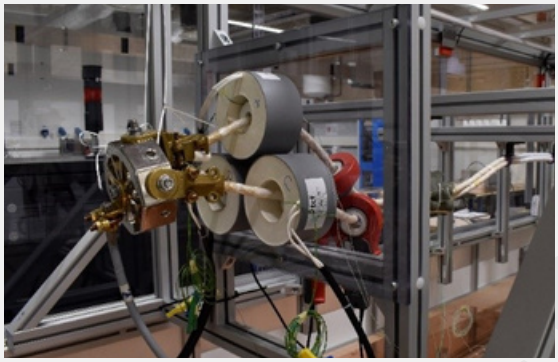
• **Resolved issue:** characterisation of material insulation properties, ageing test under representative operational conditions

• **Sample**: electrical harnesses, component, electronic devices

• **Description**: With the increased switching speed of converters with wide bandgap transistors, electrical stresses are much higher and trigger accelerated aging of insulation systems. We offer to characterize and develop the performance of insulating materials in order to correlate mathematical models and tests.
Likewise our ageing test platform helps to quantify the design margins of railway insulation systems (rotating machines, cables, transformers) in anticipation of the switch to wide bandgap-based components in electromechanical converter chains.

• **Unique Advantages**: Our devices allows characterizing electrical properties of electrical insulating materials (dielectric constant, loss factor, etc.) according to the operating frequency and temperature of the system. This kind of characterization is important to design system with regard to partial discharge and to compare high performance materials. Thermal cycling is a constraint for almost all electrical components. It can be reproduced with fast-variation temperature chambers. It can be also highly accelerated with our dedicated water-cooled test bench

Thermal cycling ageing © IRT Saint Exupery



Electrothermal test bench for harnesses © IRT Saint Exupery

Soft magnetic materials characterization

• **Market**: Electrical systems, electronics, automotive, aerospace, and defence.

• **Resolved issue:** Iron losses are a main parameter in electrical motor design. However, between data coming from the iron sheets suppliers and measurements on the final assembled product, differences of several tenth of percent are common. Our testing systems allow characterization of materials with conditions closer the final uses-cases for direct use or as inputs for enhanced modelling tools.

• **Sample**: electrical harnesses, component, electronic devices

• **Description**: Our Characterization Lab enables to evaluate losses of magnetic materials used in electrical machines.

• **Unique Advantages**:
- Our hysteresigraph has a broad operating range and various test coils allowing a high flexibility for testing ferrite cores, single sheets, Epstein strips and full stator stacks.
- Our Rotational Test rig enables to measure iron losses in operating conditions as close as possible to the ones in actual electrical machines.

Electromagnetic tester © IRT Saint Exupery


Iron losses measurement test © IRT Saint Exupery

Dielectric characterization & Ageing of electrical insulation

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Faraday chamber & investigation tool © IRT Saint Exupery

ITE IPVF

Presentation

IPVF – Institut Photovoltaïque d'Île-de-France, founded in 2013 particularly under the initiative of the French government, is a global Research, Innovation and Education center, which mission is to accelerate energy transition through science & technology.
Bringing together recognized industrial leaders (TotalEnergies, EDF, Air Liquide, Horiba and Riber) and world-renowned academic research teams (CNRS, Ecole Polytechnique), IPVF' multidisciplinary and international teams conduct research dedicated to clean energy technologies (photovoltaics, green hydrogen, etc.).
IPVF has built an ambitious scientific and technological research program, and has an extensive experience in III.V, perovskite solar cells, nanoscale fabrication and characterization, and devices/materials modeling.

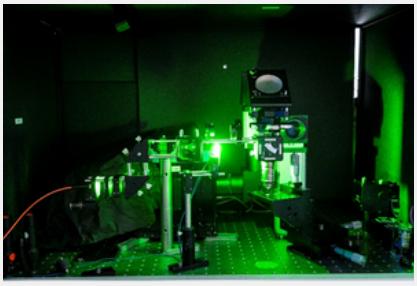
FOR WHICH INDUSTRY?

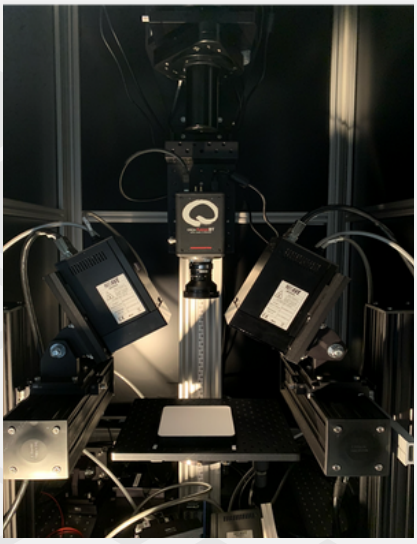
More particularly for the photovoltaic industry

OUR ASSETS

IPVF provides access to high-level experimental platform of 8,000 m², located in Paris-Saclay, and comprising more than 120 cutting-edge equipment worth €30M. These plaform is a unique plaform for all types of deeptech research and innovation.

Hyperspectral : Investigation on all types of semiconductors and solar cells materials





Hyperspectrals ©IPVF

• **Market**: Investigation on all types of semiconductors and solar cells materials

• **Resolved issue:** Determine the lifetime and distribution of carriers after light excitation. Measure defect luminescence, thermalization effects…

• **Sample**: Imaging an area of 20 x 20 cm² (for Wide field one).

• **Description**: Hyperspectral imaging allows for measuring light emission spectrum/properties at each point on the surface material placed under managed excitation conditions. Ultrafast imaging by streak cameras.
At IPVF, we manage numerical models that allow in depth understanding of luminescence levels and spectra obtained on each point of the material surface. This gives previous information on defect types, loss mechanisms and many more physical phenomena at stake. A precious know-how when struggling with theoretical efficiency limits predicted by physics.

• **Unique Advantage**s: Scanning UV-Visible spectral range (300-1100 nm) and near IR (800-1800 nm).

Qualitative & Quantitative analysis of different materials: X-Ray Fluorescence

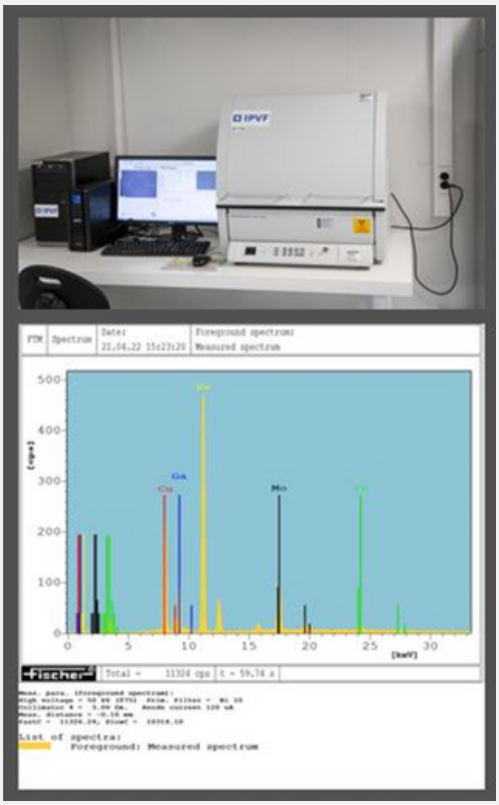
• **Market**: Automotive & Aerospace, Construction Industries, Metal fabrication, Scrap Metal & Precious Metal recycling.

• **Resolved issue:** Identify alloys, detect tramp elements, deliver geochemical data, analyze precious metals, and determine coating weight and plating thickness, to ensure material chemistry specifications are met.

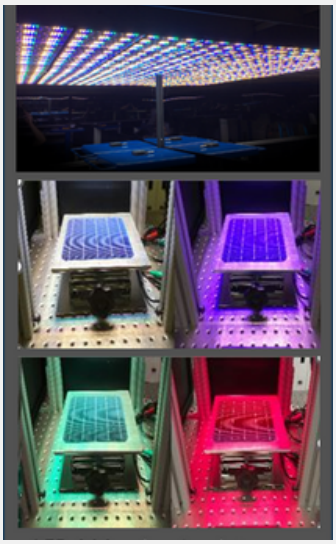
• **Sample**: Metal, Plastics & Minerals. Maximum Sample size: 30×30² cm and maximum sample height: 5 cm

• **Description**: XRF analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Each of the elements present in a sample produces a set of characteristic fluorescent X-rays (“a fingerprint”) that is unique for that specific element.

• **Unique Advantage**s: Non-destructive analytical technique used to determine the elemental composition of materials. Because XRF enables the simultaneous detection of elements, it is well suited to rapid qualitative, quantitative and semi-quantitative analysis of materials.



FISCHER Model: XDV-SDD series ©IPVF



LED AAA solar simulator ©G2VOptics.Inc.

LED Solar Simulator Class AAA

• **Market**: Aerospace, Photovoltaic devices, Solar fuels, Light sensitive materials.

• **Resolved issue:** Typical applications include visible-light photocatalysis, artificial photosynthesis and photo-electrochemical detection.

• **Sample**: Solar cells and samples up to 20 x 20 cm²

• **Description**: A LED Solar Simulator provides illumination approximating natural sunlight (AM1.5G) in the wavelength range of 400 to 1400 nm. It assures controlled and repeatable laboratory conditions of spectral content, spatial uniformity and temporal stability for photo-electrochemical experiments meeting class AAA specification.

• **Unique Advantage**s: Class AAA solar simulation technology for the most accurate research outcomes.

ITE SUPERGRID INSTITUTE

Presentation

SuperGrid Institute offers tests and characterisation for dielectric materials used in industrial applications where it is necessary to define the design and dimensions of the insulator according to the medium used and the stress conditions it is subject to.

FOR WHICH INDUSTRY?

High & medium voltage equipment manufacturers, insulator and material manufacturers and suppliers, semiconductor manufacturers.

OUR ASSETS

State-of-the-art test and characterisation platforms. pooling the expertise of accomplished specialists from numerous domains of research in a collaborative work environment.

Space charge measurements by Pulsed Electro Acoustic method (PEA)

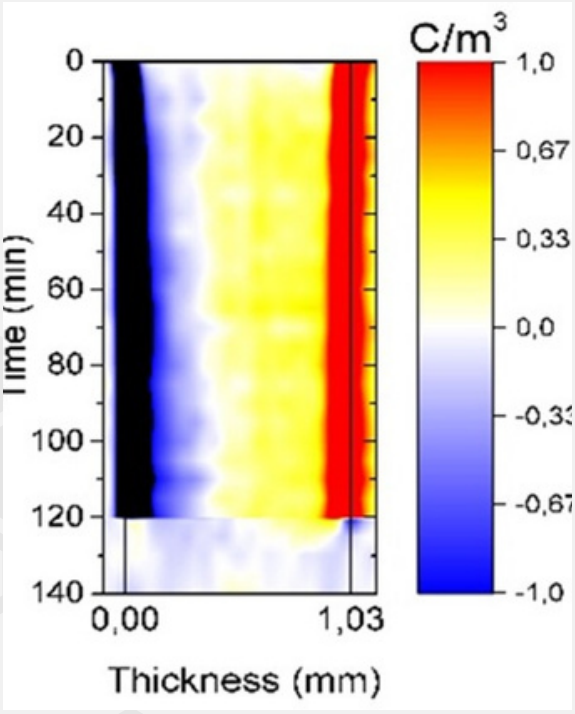


Figure: Results of space charge measurements on silicone insulation © SuperGrid Institute

• **Market**: High Voltage & Medium Voltage equipment

• **Resolved issue:** Assessing the impact of space charge phenomena on the ageing of different insulating materials.

• **Description**: Measurements for any industrial application requiring the dimensioning of objects subject to DC electric field conditions (electrical networks, mobility, etc.). Measurement of space charges in a solid electrical insulator under different conditions (electric field and temperature). Limits: up to 70°C and 30kV. The samples used are typically thin membranes a few millimeters thick.

• **Unique Advantage**s: Combined with SuperGrid Institute's expertise in direct current and other characterisation methods such as DC conductivity, we can support our clients from drawing up specifications to defining the design criteria for their object.

DC Conductivity test platform

• **Market**: High Voltage & Medium Voltage equipment

• **Resolved issue:** Assessing the performances of insulating materials under DC current.

• **Description**: Measurements for any industrial application requiring the dimensioning of objects subject to DC electric field conditions (electrical networks, mobility, etc.). Measurement of the DC conductivity of an insulating material (gas or solid) under different conditions (electric field, humidity, temperature, etc.), up to 100°C and 40kV.

• **Unique Advantage**s: A unique characterisation asset designed by the SuperGrid Institute team. Automated parameter setting operations enable experimental campaigns to be controlled and reproduced.

Fig: Photo of the measurement samples being placed in the platform © SuperGrid Institute

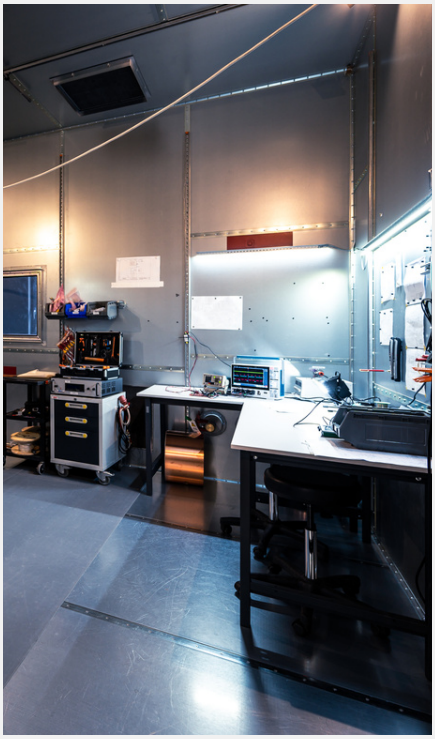


Fig: The Medium Voltage insulation high dV/dt test platform © Lotfi Dakhli Photographe

Medium Voltage insulation high dV/dt test platform

• **Market**: Medium Voltage grids, electrical motors

• **Resolved issue:** Assessing the performances of insulating materials subjected to steep dV/dt. Design validation of Medium Frequency Transformers, motors.

• **Description**: The platform can apply sine or square wave excitations up to 8kV and 100kHz. A current of 500A can be achieved with a voltage of around 1kV.

• **Unique Advantage**s: High dV/dt, medium frequency and medium voltage excitations. Possibility of high-current testing.

ITE INES.2S

Presentation

The aim of INES.2S is to support the development of the French photovoltaic solar industry, by developing multi-partner public-private R&D at world-class level and then promoting the transfer of the technologies developed to industrial players. The mission is to strengthen the French economic and industrial fabric to enable the national energy transition, calling for a strong integration of solar energy in all types of systems (ground-mounted power plants, buildings, mobility, agriculture, industry, etc.) and, more generally, its integration into the territory. The framework for this national energy transition is the Pluriannual Energy Programming Act.

INES.2S is part of the drive to increase the share of solar energy in the national electricity mix by 2035. Its aim is to develop solutions for the mass integration of solar energy. The use of photovoltaics is a new global dynamic that concerns all surfaces (buildings, industrial zones, infrastructures, or even rolling-floating-flying vehicles), enabling them to be made functional and/or reducing their environmental impact.

OUR PARTNERS

INES.2S is a consortium of 5 industrial partners (Compagnie Nationale de Rhône, Colas, Renault, SteadySun and DeltaDore), CEA, as research leader and operator, and also includes an academic partner, the University of Savoie Mont Blanc, as well as a vocational training partner, INES Plateforme Formation et Evaluation.
In addition to these Members, who are involved in the governance, INES.2S has a large number of Associated Partners, with a total of 74 manufacturers making up its ecosystem by the end of 2023.

FOR WHICH INDUSTRY?

Any company or organisation requiring R&D assistance for the development of products and services concerning PV modules or PV systems, including smart grid integration and storage systems.

OUR ASSETS

INES.2S counts on a large spectrum of heavy research infrastructure investments that are operated by the CEA.
These include several facilities listed on the next page.

ITE INES.2S

Facilities	Description
PV Modules	Experimental production of custom-made photovoltaic modules that can be integrated into buildings and vehicles.
Buildings	Research and development of system architectures for integrating solar energy into buildings
Storage	Research and development on battery performance and advanced control algorithms
Grid Control Lab	Research and development of management algorithms for PV integration in electrical networks and systems
Converters	Low and medium voltage static converter design laboratory
PV Performance	Outdoor PV component test platform
PV Diagnostics	Digital platform for managing and processing PV data

ITE INES.2S

PV everywhere

INES.2S develops advanced PV technologies that are well adapted to the specific requirement of novel kinds of applications, such as

- Buildings,
- Vehicles, Ships, space crafts,
- Agrivoltaics, linear PV power plants,
- Medium voltage PV power plants

Industrial scale facility for the development and manufacture of specific photovoltaic modules. © D. Guillaudin, CEA

A first prototype of an electric car with integrated PV system. © CEA

Massive grid integration

Solar energy is becoming a more and more important player to support the energy mix. INES.2S develops solutions required for the massive grid integration of solar energy:

- Advanced solar converters operating in the medium voltage range
- Intelligent energy management systems operating on local and aggregated level
- Grid coupled storage systems

Characterising a stationary storage system for grid support. © P.Aviadan, CEA

IRT RAILENIUM

Presentation

Railenium, the French railway technological institute, has been created in 2012 and emerged as an authentic tool at the service of the railway industry. Railenium runs research and innovation projects, bonding together academics and industry partners. Railenium develops, validates and tests groundbreaking technologies and innovative solutions for the railways industry, be it in France or abroad, especially in the frame of CORIFER, the French national innovation roadmap for railway industry; or Europe's Rail JU programs. The technical, societal, environmental and safety challenges are numerous and Railenium is willing to face them.
Railenium tackles problematics all over the railways system, starting from the infrastructure (rails, sleeper crews, ballast…), to the rolling stock (wheels, bogies, obstacles detection devices…), up to the energetic supply (batteries, pantograph, catenaries, transformers…), AI, BIM techniques and Human and Organizational Factors (HOF). Thanks to the expertise of its teams, Railenium is able to address technological and scientific problems in the fields of artificial intelligence, IoT, data science and digital twin, modelling applied to railways industry, safety, operational safety.

OUR PARTNERS

Railenium is supported by 9 industrial founding partners, being Alstom Transport, Bouygues TP, Eurotunnel, Fédération des Industries Ferroviaires (FIF), i-Trans, Groupe SNCF, SNCF Réseau, Vossloh Cogifer, as well as 4 academic founding partners: Université Gustave Eiffel, Université Polytechnique des Hauts de France, Université des Sciences et Techniques de Lille and Université de Technologie de Compiègne. It is also associated over 20 supplementary industrial and academical associate members as well as numerous project partners.

FOR WHICH INDUSTRY?

Railways industry, energy, environment

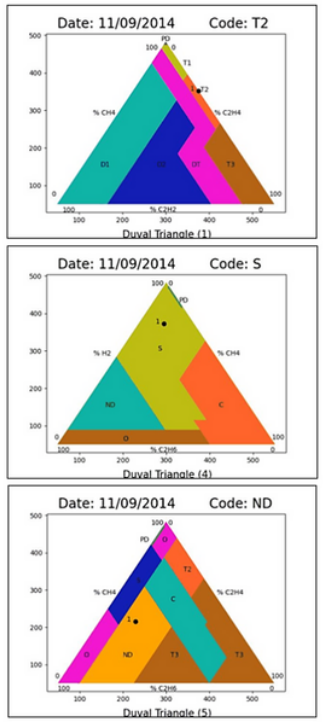
Ageing of paper insulation transformers

• **Market**: Railway, energy distribution

• **Resolved issue:** Characterization of traction transformer faults based on the dielectric fluid analysis

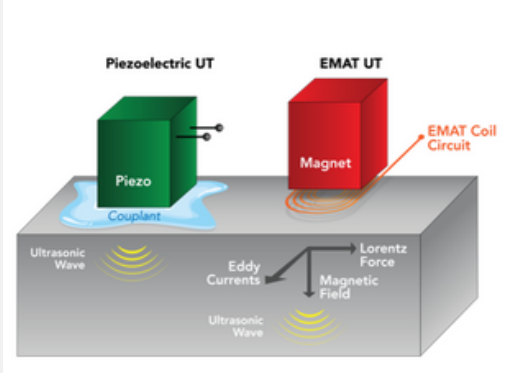
• **Description**: Dissolved gas analysis (DGA), cellulose insulation analysis and dielectric fluid analysis enables to estimate the health condition and the Remaining Useful Life (RUL) of any oil immersed transformer.

• **Unique Advantage**s: Ability to accurately provide the health index and the RUL for different traction transformer technologies (1.5kV, 25kV) using robust approaches.
This tool can predict the impact of fault using the historical data characterization analysis and gives maintenance recommendations to increase life time of transformers.



Duval Triangle (CH4, C2H4 and C2H6 %) for a case study of SNCF Réseau substation. ©Railenium

EMAT cracks detection trolley



Crack detection and characterization trolley using EMAT sensors. EMAT principle compared to classical piezoelectric testing method is indicated below. ©Railenium

• **Market**: Railways

• **Resolved issue:** Detection and characterization of the dimensions of cracks in railways in large networks.

• **Sample**: Any shape of rails (subway, Eurotunnel, LGV…).

• **Description**: Characterization trolley with several detection sensors detecting and characterizing the depth and dimensions of surfacic or close surface defects, such as cracks or phase changes (e.g. White Etching Layer). The trolley is motorized and can semi-autonomously collect data. Room for additional sensors is available for specific applications.

• **Unique Advantage**s: Motorized and relatively fast analyses (up to 30 km/h). Contactless detection suppressing the need for a couplant and improving the lifetime of the sensors.

CONTACTS

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OUR LINKEDIN PAGE: https://www.linkedin.com/showcase/platform-for-advanced-characterisation-grenoble-pac-grenoble/

NANOELEC.
Platform for Advanced Characterisation | PAC-G

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IPVF

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OUR WEBSITE: www.ines2s.org

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OUR PARTNERS

FIT - French Institutes of Technology

About the French Institutes of Technology Association

The research institutes of technology (IRT) and the institutes for energy transition (ITE) are interdisciplinary and thematic institutes created as part of the French government's "Investissements d'Avenir" program. They contribute to the development of economic sectors linked to their fields through a balanced public-private strategic cooperation. They are based on long-term partnerships between higher education and research establishments and companies.

To this end, they manage research programs coupled with technology platforms, carry out research and development work at the highest international level, contribute to the engineering of initial and continuing training (professional training leading to qualifications and/or diplomas) and ensure that the results obtained are put together for a good use. They generate results, skills, knowledge and know-how that can be directly exploited in their economic sectors, with the ITEs focusing on sustainable development and the fight against climate change.

The creation of IRTs and ITEs in the national landscape has led these institutes to join forces to develop a common vision and approach to the new issues generated by their operational implementation and development, by creating an association called "French Institutes of Technology" (FIT).

The purpose of the association is to :

- strengthen the attractiveness and promote the model of the Institutes, in their structural and organizational diversity, both nationally and internationally;
- promote exchanges between its members and the coordination of their actions to optimize their operating efficiency, development and sustainability;
- represent the institutes in dealing with the French government and the European Commission;
- develop coherence between the various objectives of the "Investissements d'Avenir" program and all other research and innovation programs, in particular by strengthening links between the academic and industrial worlds. This coherence can also be illustrated between Institutes by identifying common thematic areas of scientific and technological cooperation.

FRENCH INSTITUTES OF TECHNOLOGY

OUR PARTNERS

STREAMLINE

STREAMLINE is a 54 month project, which kicked off in November 2019 and will be concluded on 14 May 2024. The project is funded by the European Commission in the context of Horizon 2020.

It aims to ensure the long-term sustainability of the European Synchrotron Radiation Facility (ESRF) in the context of its upgrade to be the first in a new generation of synchrotrons. The ESRF is a user-based research infrastructure, serving 7,000 researchers annually.

STREAMLINE also aims to promote the new opportunities for research to existing users and new scientific communities. Benefits are felt by both academia and industry.

In 2020, the ESRF's Extremely Brilliant Source (ESRF-EBS), which is a 2018 ESFRI Roadmap Landmark, has begun user operation delivering a revolutionary new fourth-generation synchrotron and adding four new state-of-the-art X-ray beamlines.

Thanks to an initial x100 beam brilliance enhancement and x50 in coherence, with particularly strong impact for micro- and nano-beams, ESRF-EBS is enabling novel experimental capabilities across basic, applied and industrial science on all of ESRF's 44 X-ray beamlines, addressing major societal challenges.

STREAMLINE

OUR PARTNERS

France 2023

France 2030 has one ambition: to prepare the France of tomorrow. This will be achieved by making major strategic investment choices to serve our fellow citizens and by pursuing a strong ecological ambition, so that we can produce better, live better and understand our world better. This means It's about both catching up in some of our historic sectors, and giving France a head start by creating new industrial and technological sectors to support the ecological and digital transitions. France 2030 is part of the strategy pursued since the start of the five-year term to promote innovation and re-industrialisation.

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