# Smart battery casing in nanocomposite for aeronautic applications

**At a glance:** Develop a solution for a lightweight/safe/efficient/cost-effective smart casing for batteries pack based on nano-enabled composites material + network of integrated sensors for in-operando diagnosis of batteries modules.

**Keywords:** **smart composite, integrated sensors, weight reduction, thermal runaway prevention**

## Context:

- Thales is one of the world-leading suppliers of electrical systems with innovative solutions for commercial, military aircrafts and business jet. OASIS outcome will be an opportunity to promote new technologies on the next generation of aircraft platforms. Emerging markets are also expected in urban mobility (air taxi) with the full electric or hybrid vehicles.

- The objective is to develop an innovative and safe casing for an aircraft battery designed for a 28V DC grid.

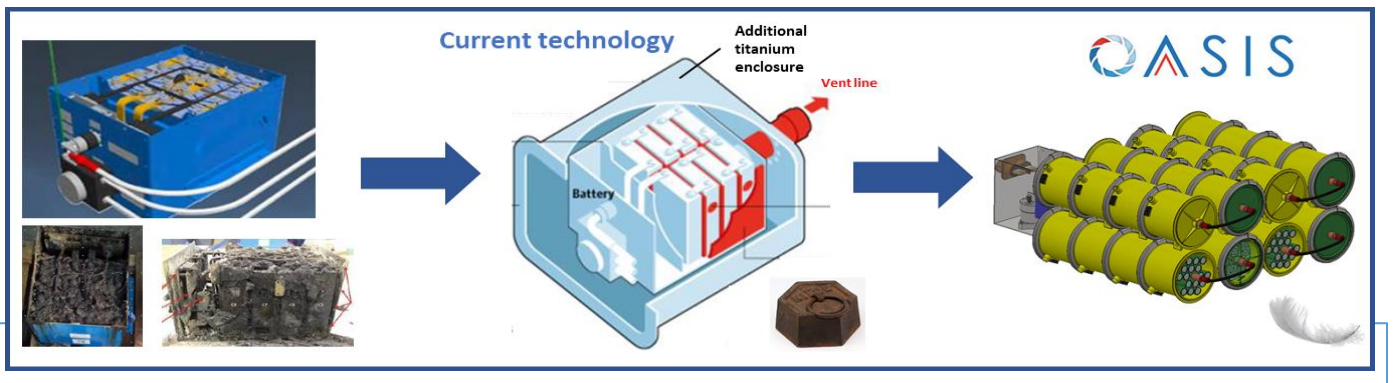
## The Challenge:

The partnership between Thales and OASIS service providers aims at developing a new casing solution for avionic battery packs that is lighter and safer, **with 2 axes of improvement**:

- Addition of suitable nanomaterials to improve thermal and mechanical properties, contain thermal runaway and reduce weight structure
- Integration in the casing structure of a network of non-intrusive printed sensors, providing multiple information to prevent thermal runaway: Temperature, pressure or acoustic emission.

**This showcase has then 3 main technological KPI** :

- Increase gravimetric energy density of the battery module by 10-20%.
- Resistance to thermal runaway of one cell, reducing the risk of fire propagation.
- Anticipated detection of thermal runaway.




## The Results:

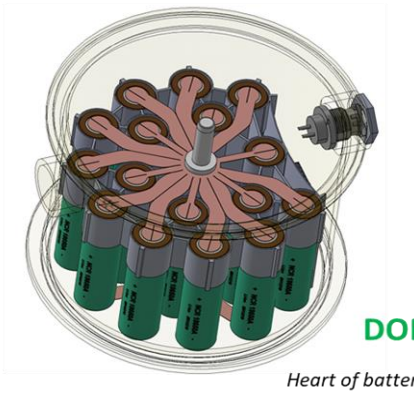
Adequate materials for each casing part have been selected thanks to electrical, chemical and mechanical evaluations. Multiple ply PPS/C with two external PPS/glass folds and overmolding of PPS/glass have been chosen. Simulation and modelling of thermal and mechanical behavior of the materials in the casing have shown that it can resist pressure up to 20 bars. The designs of the casing parts have been done and adjusted based on the selected material and fabrication processes.

Fire retardant nanoparticles developed by Fraunhofer have been evaluated into prepreg fabricated by Adamant but have showed no real improvement on the flame propagation. They have not been finally integrated in the casing within this project.

The type, the design, the location of sensors in the casing have been evaluated. Printed thermo-couple on Kapton + printed PVDF piezoacoustic sensors are employed within the material of the lid and bottom and on the support of the different battery cells.

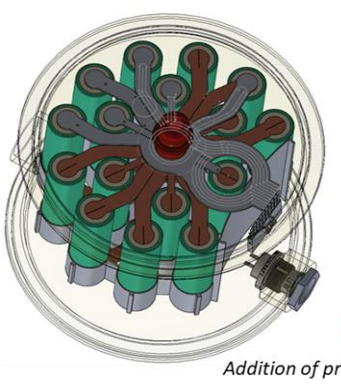
Several specific molds have been developed. The characterisation of materials after molding have shown the expected materials properties. The design of a reference casing at TEC made of aluminium presents a global weight of 21 Kg. A 18% gain using our composite materials have been then attained.

## DESIGNS :



DONE

*Heart of battery module*



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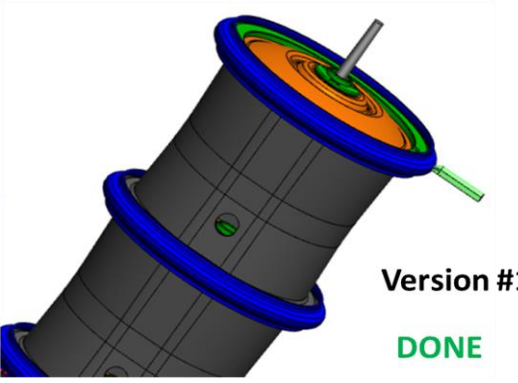
*Addition of printed Sensors*

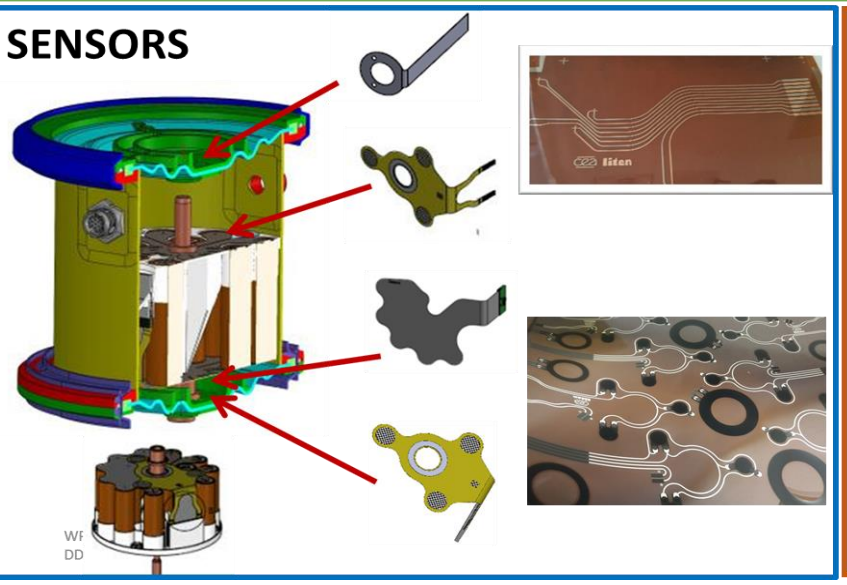


Version #17

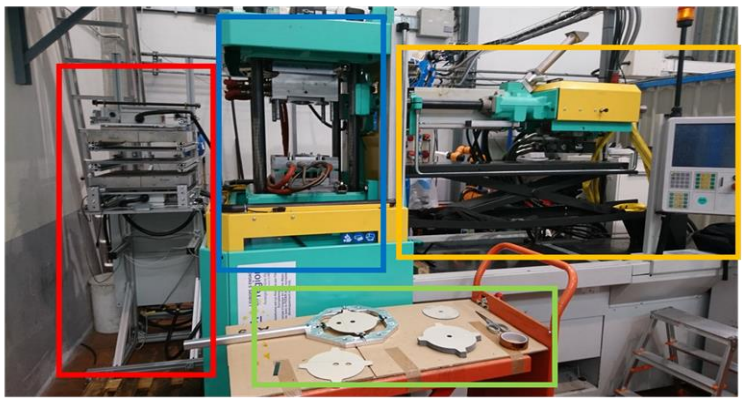
DONE

***Final Design of the casing** of the battery module*

## SENSORS



## FABRICATION



Infra-red Heating 360 °C

Mould @ 150 °C

Composite preparation

Injection unit

## Conclusion:

Thales is very satisfied by the work that have been done and the important implications of the different pilot lines.

This successful collaboration leads to the definition of an unique and specific device for Thales in a very short time: a nano-enabled composite smart casing reaching our KPIs for a safier and lighter battery module, thanks to :

- Suitable materials from PLs,
- specific designs,
- advanced production processes,
- relevant experimental tests and simulations
- combined expertise from every specialist involved

Results are meeting Thales expectations as they had a direct access to the most relevant, reliable and advanced solutions for the development of a safer lithium-battery pack for avionic applications. They also had the possibility to evaluate/benchmark different new nano-enabled composites and other smart material technologies and advanced processes for high-productivity/high performance systems and parts.

## OASIS Technique:

- **PL#3:** flame-retardant nanoparticles
- **PL#7:** Large area printed electronics
- **PL#6:** Functionalised prepregs
- **PL#11:** Smart hybrid composite parts fabrication
- **PL#8:** Die casting reference evaluation

### Characterization services:

- Physical-chemical and mechanical characterisations and evaluation,
- Durability tests,
- electrical conductivity

### Simulation services :

- design adjustment and modelling of mechanical and thermal properties, thermal & flow simulation

OASIS SC4

Get in touch today for further details:

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**Open Access Single entry point for scale-up of Innovative Smart lightweight composite materials and components**

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