HARVEST

Hierarchical multifunctional composites with thermoelectrically powered autonomous structural health monitoring for the aviation industry
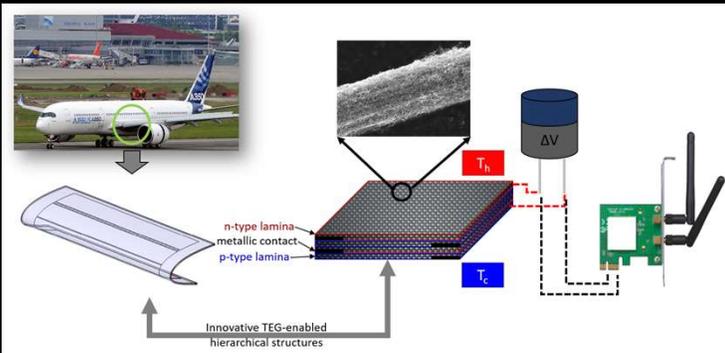
THE PROJECT

HARVEST is an ambitious 36 month project, aiming at developing multifunctional composite materials capable of energy harvesting, structural health monitoring (SHM) and self-repairing, targeting the aeronautics sector. In HARVEST, each constituent material is selected so as to impart specific functionalities aiming at providing the aerospace sector with a safer, more economic and environmentally friendly structural material.

HARVEST will cover the whole value chain of fiber reinforced plastics (FRPs) so as to provide novel FRPs capable of harvesting and storing thermoelectric energy. In addition, HARVEST will develop a purposefully made electronic circuit module so as to power SHM inherent functionalities and provide information on the structural health of the components.

CONCEPT

HARVEST project will employ breakthrough technologies combining bio-inspired hierarchical ThermoElectric Energy Generating (TEG) carbon fiber (CF) reinforcements with novel thermoset matrix systems (3R Repair-Recycle-Reprocess technology).

The "hierarchical" reinforcement will be made of micron-scale CF coated with nano-scaled particles.

The aim is to develop multifunctional TEG-enabled structural composite materials for the Aeronautics sector.

OBJECTIVES

✓ Biomimetic hierarchical TEG-enabled CF reinforcements by R2R deposition of nanoparticle (NP) based inks

✓ Smart 3R (Repairable, Reprocessable, Recyclable) nano-modified polymeric matrices with self-sensing and self-repairing capabilities

✓ Simulation of materials TEG performance using advanced analytical and numerical tools, at different length scales

✓ TEG-enabled laminated multifunctional composite structures with optimized number of p-n serially interconnected laminae

✓ Electronic system (software & hardware) responsible for managing the energy harvesting, structural health monitoring (SHM) data accumulation and transmission

✓ Two Aeronautics Demonstrators and validation of their multifunctional capabilities under operational environments
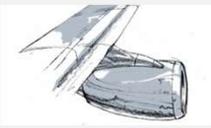
KEY TECHNOLOGIES
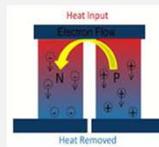
TEG-enabled composites
Unique composite materials capable of thermoelectric generation (TEG) toward a decrease of wasted energy during flight
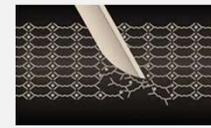
Self-repair materials
Novel thermoset matrix systems with 3R functionality (Repair; Recycle; Reprocess) toward increased safety and prolonged operational time

Self-powered SHM
Autonomous Structural Health Monitoring system toward reduced inspection and maintenance costs

IMPACT

HARVEST demonstrators with TEG capability, autonomous SHM, self-repairing and self-powering capabilities, will result in:

✓ a substantial decrease of the environmental impact of aircrafts,
✓ an enhancement of the safety in the Transport sector,
✓ an increase of competitiveness, sustainability and growth for the European Aerospace & Nanomaterials sectors.

More specifically, HARVEST multifunctional materials are expected to:

✓ increase safety and prolonged operational time, through self-repairing functionality
✓ cut end-of-life (EOL) waste material of the aerospace sector, through recyclability capability
✓ decrease wasted energy during flight, through thermoelectric generation (TEG) functionality
✓ realize a self-powered Structural Health Monitoring (SHM) system, through energy harvesting functionality
✓ diminish inspection/maintenance/repair costs, through Structural Health Monitoring (SHM) functionality
✓ strengthen competiveness of European industries, SMEs and Academia, by boosting their know-how and expertise for large-scale and cost-efficient manufacturing of TEG-enabled smart composites.

PARTNERS

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