PROJECT

ELECTRICAL

Novel Aeronautical Multifunctional Composite Structures With Bulk Electrical Conductivity And Self-Sensing Capabilities

Funding: European (7th RTD Framework Programme)

Duration: Oct 2010 - Jun 2014

Status: Complete with results

Total project cost: €4,608,275

EU contribution: €2,878,153

Call for proposal: FP7-AAT-2010-RTD-1

CORDIS RCN : 96976

Background & policy context:

Aircraft structures appear to be strategic components to be manufactured in composite materials for reducing weight. New questions regarding electrical conductivity have arisen such as static discharge, electrical bonding and grounding, interference shielding and current return through the structure.

These functions can be met by the use of technologies based on nano composites, which indeed combine mechanical properties, electrical and thermal conductivity.

Objectives:

Based on the needs to provide advanced concepts and technologies for increased and optimised use of light-weight composite smart materials, the main objective of ELECTRICAL is the development of novel multifunctional composite structures with bulk electrical conductivity and self-sensing capabilities.

The project will investigate and develop alternative emerging methods to manufacture nano-reinforced carbon-based composites compatible with current industrial manufacturing processes of composites.

The main goals will be:

- Development of innovative technologies to convert nano-fillers into engineered multifunctional pre-forms, prepregs, bucky-papers, etc, for further use in CFRP structures. CNTs bulk doped resins are also to be considered as the main baseline;
- Manufacture, characterisation and test CFRP based materials with such multifunctional engineered nano structures.

Methodology:

Liquid moulding technologies will be considered, although autoclave technology will also be considered as the second alternative. The three main functionalities will be:

- Electrical conductivity of aeronautical composite structures to meet requirements regarding static discharge, electrical bonding and grounding, etc;
- Monitoring and optimisation of CFRP curing process by Dielectric Mapping;
- Quality assurance of final component (de-laminations, etc) by Electrical Resistance Tomography (ERT).

Parent Programmes:

FP7-TRANSPORT - Transport (Including Aeronautics) - Horizontal activities for implementation of the transport programme (TPT)

Institute type: Public institution

Institute name: The European Commission

Funding type: Public (EU)

Lead Organisation:

Fundacion Tecnalia Research & Innovation

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PARQUE CIENTIFICO Y TECNOLOGICO DE GIPUZKOA PASEO MIKELETEGI 2
20009 DONOSTIA/SAN SEBASTIAN (GIPUZKOA)
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Organisation Website:
http://www.tecnalia.com

EU Contribution: €633,363

Partner Organisations:

Short Brothers Plc

Address:
Airport Road, Queens Island
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Organisation Website:
http://www.aerospace.bombardier.com

EU Contribution: €200,833

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Organisation Website:
http://www.advanced-composites.com

EU Contribution: €199,880

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EU Contribution: €201,900

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Organisation Website:

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EU Contribution: €52,537

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http://www.airbus-group.com

EU Contribution: €175,000

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Organisation Website:
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EU Contribution: €202,219

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Organisation Website:
http://www.airbus.com

EU Contribution: €68,500

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Organisation Website:
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EU Contribution: €22,500

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Organisation Website:
http://www.arkema.com

EU Contribution: €115,100

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EU Contribution: €197,880

Fundacja Partnerstwa Technologicznego Technology Partners

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Organisation Website:
http://www.technologypartners.pl

EU Contribution: €187,500

Association Pour Le Developpement De L'enseignement Et Des Recherches Aupres Des Universites, Des Centres De Recherche Et Des Entreprises D'aquitaine

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Avenue Du Docteur Albert Schweitzer - Centre Condorcet 162
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EU Contribution: €331,441

Panepistimio Patron

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Organisation Website:
http://www.upatras.gr

EU Contribution: €289,500

Technologies:

Nanomaterials
Nanoreinforced carbon-based composites

Development phase: Research/Invention

Key Results:

Nanomaterials for advanced composites

Increasing the fraction of non-metallic components in aircraft has given rise to questions regarding electrical conductivity. An EU-funded project exploited nanotechnology to develop novel multifunctional composite materials that can efficiently conduct electric current.

Inclusion of carbon nanotubes (CNTs) into a polymer matrix provides potential for creating materials with multifunctional properties. However, several issues need to be overcome to successfully introduce electrically conductive nanoparticles into polymer composite laminates. For example, the increased viscosity of resin and the filtration of nanoparticles lead to defective laminates. Another important issue

related to the increasing use of carbon fibre reinforced polymers (CFRPs) is the lack of reliable methods for quality control.

The EU-funded project ELECTRICAL (Novel aeronautical multifunctional composite structures with bulk electrical conductivity and self-sensing capabilities) worked on further developing the exciting potential of nano-reinforced resins in terms of their electrical and mechanical properties.

Scientists worked on alternative emerging methods for manufacturing nano-reinforced carbon-based composites compatible with current industrial manufacturing processes of composites. Various state-of-the-art fabrication technologies to convert CNT nanofillers into engineered multifunctional preforms, prepregs or buckypapers were considered for further use in CFRP structures. Incorporation of nanofillers into toughened thermoplastic fibres or non-woven veils helped overcome the resin-increased viscosity and filtration effects.

ELECTRICAL exploited the CNT properties as polymeric resin doping to develop novel multifunctional composite structures with bulk electrical conductivity and self-sensing capabilities.

Dielectric mapping helped monitoring and optimising the CFRP curing process. This technique takes advantage of the CNT electrical conductivity to perform non-invasive electrical measurements of the material in the vicinity of the dielectric sensor. Furthermore, the piezoresistive CNT behaviour enabled development of innovative CFRP structures with distributed or localised self-sensing capabilities, enabling quality assurance of the final component.

ELECTRICAL activities and outcomes should help increase the competitiveness of European aeronautical companies against their international counterparts. The primary market is composite fuselage parts for the next generation of large aircraft. In addition, the advanced composite materials may find applications in other markets such as space, automotive and rail.

Documents:
Periodic Report Summary 2 - ELECTRICAL (NOVEL AERONAUTICAL MULTIFUNCTIONAL COMPOSITE STRUCTURES WITH BULK ELECTRICAL CONDUCTIVITY AND SELF-SENSING CAPABILITIES)

STRIA Roadmaps: Vehicle design and manufacturing

Transport mode: Air transport

Transport sectors: Passenger transport, Freight transport

Transport policies: Other specified

Geo-spatial type: Other