PROJECT

IAPETUS

Innovative Repair of Aerospace Structures with Curing Optimisation and Life Cycle Monitoring Abilities

Funding: European (7th RTD Framework Programme)

Duration: Jun 2009 - Dec 2012

Status: Complete with results

Total project cost: €3,342,226

EU contribution: €2,339,595

Call for proposal: FP7-AAT-2008-RTD-1

CORDIS RCN : 91015

Background & policy context:

Bonded composite patches are ideal for aircraft structural repair as they offer enhanced specific properties, case-tailored performance and excellent corrosion resistance. Bonding further eliminates stress concentrations induced from mechanical fastening of metal sheets, seals the interface, and reduces the risk of fretting fatigue between the patch and the component.

The IAPETUS project focused on the use of improved composite repair systems offering: (i) the introduction of new on-aircraft simplified curing technologies, (ii) enhanced fatigue and damage tolerance properties and (iii) integrated damage sensing.

Objectives:

The project objective was to develop novel repair technologies and materials for both metallic and composite aircraft. This were realised via the usage of novel hybrid composite systems, which offer the multi-functionality that led to the development of innovative (non conventional) repair technologies and life cycle health monitoring capabilities together with the enhancement of repair efficiency.

Methodology:

This was performed via the incorporation of carbon nanotubes (CNTs) both in the composite matrix of the repair patch as well as in the adhesive. The CNT modified repair concept led to improved performance in the blunting of stress concentrations in the parent surface and the inhibition of crack propagation, leading to enhanced fatigue resistance at the locus of the repair as well as for the patch itself. At the same time, the patch repair acquires additional functionalities.

The CNT doped Carbon Composites can be tailored to reduce the galvanic corrosion in repaired Aluminium structures. As the patch becomes electrically and thermally conductive thermal energy can be infused in the patch either by direct resistance heating (using the patch itself as heating element via the application of electrical voltage) or by induction heating, to instigate a uniform matrix polymerization since the patch system appears improved thermal conductivity too. The electrically conductive percolated network can be employed to assess the damage within the patch and its interface with the repaired structure, as conductivity changes mirror the damage in the doubler/substrate system by tracing micro damage through breaches in the CNT network; thus, the structural efficiency monitoring at any stage in the service life of the aero structure can be assessed non-destructively.

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

Address:
PARQUE CIENTIFICO Y TECNOLOGICO DE GIPUZKOA PASEO MIKELETEGI 2
20009 DONOSTIA/SAN SEBASTIAN (GIPUZKOA)
Spain

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

EU Contribution: €480,126

Partner Organisations:

Hellenic Aerospace Industry S.a.

Address:
2-4 Messogion Ave.
11527 ATHENS
Greece

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

EU Contribution: €223,675

Wytwornia Sprzetu Komunikacyjnego "pzl - Swidnik" Sa

Address:
al. Lotnikow Polskich 1
21045 SWIDNIK
Poland

Organisation Website:
http://www.pzl.swidnik.pl

EU Contribution: €152,950

Gmi Aero

Address:
13 RUE GEORGES AURIC CAP 19
75019 PARIS
France

Organisation Website:
http://www.gmi-aero.com

EU Contribution: €239,850

Inasco Hellas Etaireia Efarmosmenon Aerodiastimikon Epistimon Ee

Address:
Napoleontos Zerva 18
16675 Glyfada Athina
Greece

EU Contribution: €186,899

The University Of Sheffield

Address:
Firth Court Western Bank
Sheffield
S10 2TN
United Kingdom

Organisation Website:
http://www.sheffield.ac.uk

EU Contribution: €226,440

Huntsman Advanced Materials

Address:
Klybeckstrasse 200
4057 BASEL
Switzerland

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

EU Contribution: €50,359

Panepistimio Ioanninon

Address:
PANEPISTEMIOYPOLE PANEPISTEMIO IOANNINON
45110 IOANNINA
Greece

Organisation Website:
http://www.uoi.gr / www.rc.uoi.gr

EU Contribution: €322,000

Panepistimio Patron

Address:
University Campus- Rio
26500 Patras
Greece

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

EU Contribution: €411,990

Daher Aerospace Sas

Address:
Route De Tours 23
41400 Saint Julien De Chedon
France

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

EU Contribution: €45,306

Technologies:

Composite materials
Novel Processes and Equipment in Composite Repair Technology

Development phase: Research/Invention

Key Results:

Development of novel repair technologies and hybrid materials (composites and adhesives) that will revolutionise aircraft repair processes (mainly hot bond field repair). The project has:

- Introduced an innovative curing methodology of the patch/adhesive system. The benefits of this novel methodology are homogeneous heating/curing, in addition to minimisation of developed thermal stresses. An on line monitoring system allows for precise control of curing, in order to enhance the repair quality;
- Provided direct inspection of the bonding/repair integrity, and continuous health monitoring of the repaired part;
- Increased the mechanical performance and bonding performance in the repair.

Innovation aspects

The use of carbon nanotubes incorportated both in the composite matrix of the repair patch as well as in the adhesive.

Strategy targets

Innovating for the future (technology and behaviour): *A European Transport Research and Innovation Policy*

Documents:
Final Report Summary - IAPETUS (INNOVATIVE REPAIR OF AEROSPACE STRUCTURES WITH CURING OPTIMIZATION AND LIFE CYCLE MONITORING ABILITIES)

STRIA Roadmaps: Vehicle design and manufacturing

Transport mode: Air transport

Transport sectors: Passenger transport, Freight transport

Geo-spatial type: Other