

PROJECT

NOESIS

Aerospace Nanotube Hybrid Composite Structures with Sensing and Actuating Capabilities

Funding: European (6th RTD Framework Programme)

Duration: Apr 2005 - Apr 2009

Status: Complete with results

Total project cost: €4,938,331

EU contribution: €3,080,818



Call for proposal: FP6-2003-AERO-1

[CORDIS RCN : 75790](https://cordis.europa.eu/rcn/75790)

Background & policy context:

NOESIS exploited the potential offered by Carbon Nano-Tube (CNT) reinforcements and focused on developing novel nano-composite components with enhanced sensing and actuating capabilities. Small loading with conductive additives (1-5% of weight) of nano particles can result in:

- property enhancements comparable to those caused by conventional loadings (15-40%) of common fillers, and
- unique value-added properties not normally possible with common fillers.

Added benefits include better processing and reduced component weight.

Objectives:

- Formation of CNT structured assemblies embedded into resin systems for sensing/actuating purposes and mechanical performance improvement of one order of magnitude;
- Conception and implementation of a multi-scale approach for designing nano-composites;
- Development of a coupled platform for mechanical sensing/actuating performance predictions;
- Design and fabrication of novel composite materials with increased damage tolerance, fracture toughness increased by 100%, fatigue performance improved by 30%;
- Design and fabrication of novel composite materials with tailored damping properties and a five-fold increase of damping ratio for low strain;
- Weight reduction of 10% compared to conventional equivalent CFRP components;
- Integration, modelling and validation of real-time sensing/actuating systems based on novel structural composite materials with real-time strain monitoring, scaling up of nano-actuation performance of CNTs to macro structures and life monitoring capability.

Methodology:

The project objectives were achieved by the development of an innovative process for the design and fabrication of tailored CNT structured assemblies into a polymeric matrix, and by linking this process to a multi-scale modelling/simulation approach. It required the implementation of innovative techniques on a manufacturing scale and an understanding of:

- the characterisation and multi-scale modeling of nano-reinforcements;
- the fabrication, characterisation and nano-mechanics analysis of nanocomposites; and
- the correlation of nano-structural factors with functional properties in these nano-composites.

The following activities were carried out:

- Formation of CNT-structured assemblies embedded into resin systems while retaining sensing/actuating properties and providing the desired mechanical performance (an order of magnitude increase in mechanical properties compared to the state-of-the-art carbon-fibre-

- reinforced composites);
- Enhancement of the co-electrospinning process as a pathway to realise this potential by aligning and carrying the CNT in the form of nano-composite fibrils;
 - Conception and implementation of a multi-scale approach for designing nano-composites;
 - Development of a coupled platform for mechanical-sensing/actuating performance predictions;
 - Development of stimuli-response nano-composites as actuators.

The project was organised into six technical Work Packages, a management Work Package, and a dissemination and exploitation Work Package.

Parent Programmes:

[FP6-AERO-1.1 - Strengthening competitiveness](#)

Institute type: Public institution

Institute name: European Commission

Funding type: Public (EU)

Lead Organisation:

Integrated Aerospace Sciences Corporation (Inasco)

Address:

Miaouli St., 22
MOSCHATO - ATHENS
Greece

Organisation Website:

<http://www.inasco.com>

EU Contribution: €0

Partner Organisations:

Israel Aerospace Industries Ltd.

Address:

Ben Gurion International Airport
Lod 70100
Israel

Organisation Website:

<http://www.iai.co.il>

EU Contribution: €0

Ateca

Address:

Lieu-dit VERLHAGUET
82000 MONTAUBAN
France

Organisation Website:

<http://www.montauban.cci.fr/ateca/>

EU Contribution: €0

Fundacion Inasmet

Address:

Paseo Mikeletegi , Parque Tecnológico Miramon 2
20009 SAN SEBASTIAN
Spain

Organisation Website:

<http://www.inasmet.es>

EU Contribution: €0

Centre National De La Recherche Scientifique**Address:**

3 rue Michel-Ange
75794 PARIS
France

Organisation Website:

<http://www.cnrs.fr>

EU Contribution: €0

Laboratory Of Technology And Strength Of Materials - University Of Patras**Address:**

Panepistimioupolis Rion
26500 PATRAS
Greece

Organisation Website:

<http://www.mech.upatras.gr/~ltsm>

EU Contribution: €0

Brimalm Engineering Ab**Address:**

Ostergotlands 5
VADSTENA
Sweden

Organisation Website:

<http://www.brimalm.com>

EU Contribution: €0

Institut Fur Verbundwerkstoffe Gmbh**Address:**

Erwin-Schrodinger Strasse; Geb.58
KAISERSLAUTERN
Germany

Organisation Website:

<http://www.ivw.uni-kl.de>

EU Contribution: €0

Centro Ricerche Fiat - Societa Consortile Per Azioni**Address:**

Strada Torino, 50
10043 ORBASSANO (TO)
Italy

Organisation Website:

<http://www.crf.it>

EU Contribution: €0

Weizmann Institute Of Science**Address:**

Herzl St.
REHOVOT
Israel

Organisation Website:

<http://www.weizmann.ac.il>

EU Contribution: €0

Arkema S.a.**Address:**

4-8 Cours Michelet - La Defense 10
PARIS LA DEFENSE CEDEX
France

Organisation Website:

<http://www.arkemagroup.com>

EU Contribution: €0

Hellenic Aerospace Industry**Address:**

TANAGRA
23 SCHIMATARI
Greece

Organisation Website:

<http://www.haicorp.com>

EU Contribution: €0

Technische Universitat Hamburg**Address:**

Am Schwarzenberg Campus 1
21073 Hamburg
Germany

Organisation Website:

<http://www.tu-harburg.de>

EU Contribution: €0

Swerea Sicomp Ab**Address:**

PITEA
Sweden

Organisation Website:

<http://www.ifpsicomp.se>

EU Contribution: €0

Sener Ingenieria Y Sistemas**Address:**

AVENIDA ZUGAZARTE 56
48930 GETXO

Spain

Organisation Website:

<http://www.sener.es>

EU Contribution: €0

Key Results:

The expected results were novel composite structural components, exhibiting superior damage tolerance properties, tailored damping properties and combining sensing/actuating capabilities. CNTs in a polymer matrix form a percolated network with (i) electromechanical properties sensitive to applied stress, and (ii) an integrity that is measurable and linked to component structural integrity and its life expectancy. Roadmaps for the integration of these actuation technologies in future aerospace structural components were provided.

Documents:

 [Euro Nano Forum 2009.pdf \(Project presentation\)](#)

STRIA Roadmaps: Vehicle design and manufacturing, Infrastructure

Transport mode: Air transport

Transport sectors: Passenger transport, Freight transport

Geo-spatial type: Infrastructure Node