



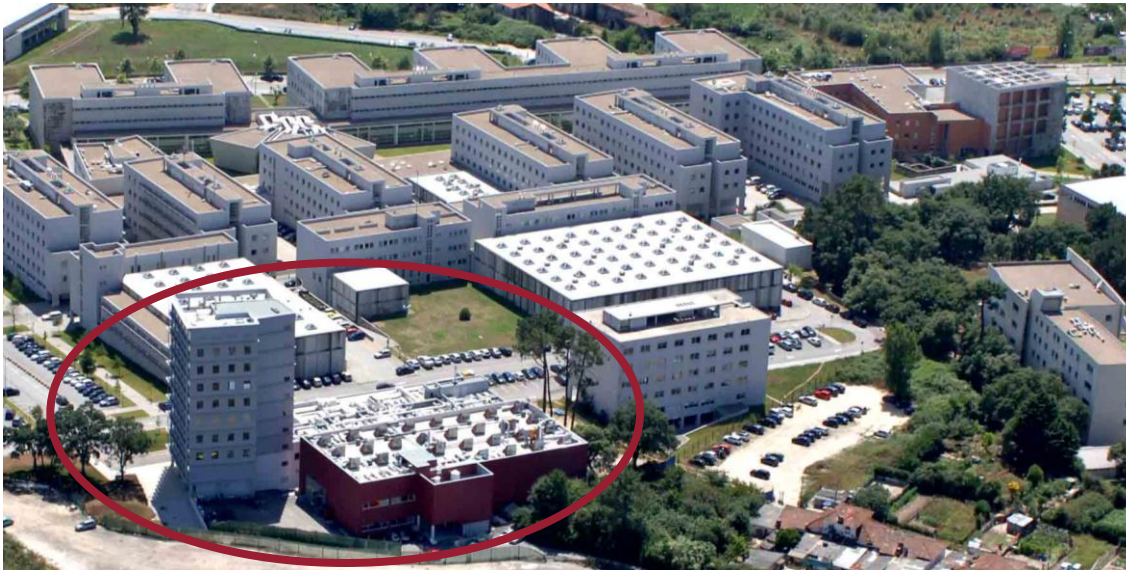
New Materials and Structures for Space

Celeste Pereira, PhD in Chemical Engineering

Aveiro, 28th November 2011

Brief presentation of INEGI

INEGI is a Research and Technology Organization (**RTO**), located at **Porto, Portugal**, focused on industry, with activities on **application oriented research**, technology transfer, technical support and services.



View of INEGI buildings in the campus of the Faculty of Engineering of the University of Porto

INEGI was founded in 1986 and has actually a permanent staff of ~100 employees (researchers, engineers, technicians and administrative personnel).

Fields of Expertise

- **Composite Materials Design and Manufacturing**
- **Testing of Materials and Products**
- **Process Simulation**
- **Structural Integrity Analyses**
- **Others:** Automation and Control, CAD/CAM/CNC, Casting Technologies / Foundry, Energy / Combustion, Equipment and Product Development, Rapid Prototyping and Rapid Tooling, Tribology and Industrial Maintenance.





Laboratory Facilities



Activities on New Materials and Structures:

(Principal Investigator: Celeste Pereira)

- 1. CNT-skeleton based composites**
- 2. CFRP composites with CNT based matrix**
- 3. CFRP composites for satellite subsystems**

CNT-skeleton based composites

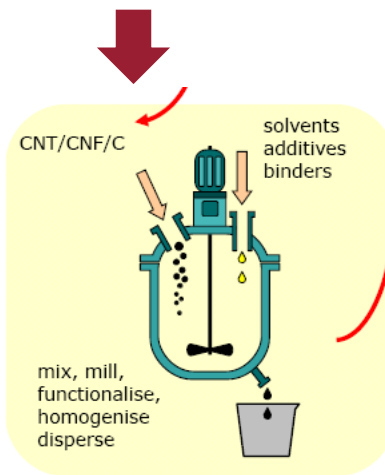
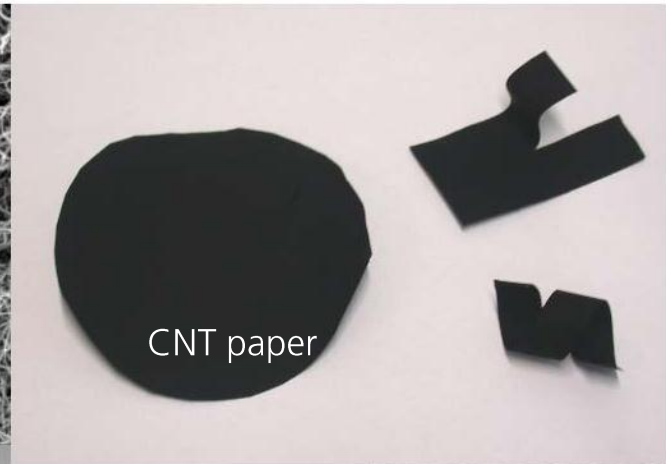
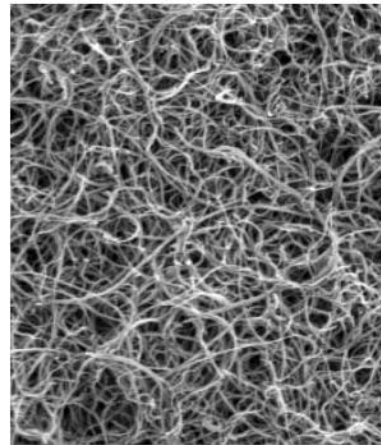
NACO: Non-conventional Matrix/Carbon Nanotubes Reinforced Composite for Applications in Space, GSTP, (2007-2009)



The main objective of this project was to develop and characterize carbon nanotube(CNT) based composites, by infiltrating nanotube skeletons with either an organic or inorganic matrix.

CNT-skeleton based composites

CNT powder



CNT-skeleton based composites



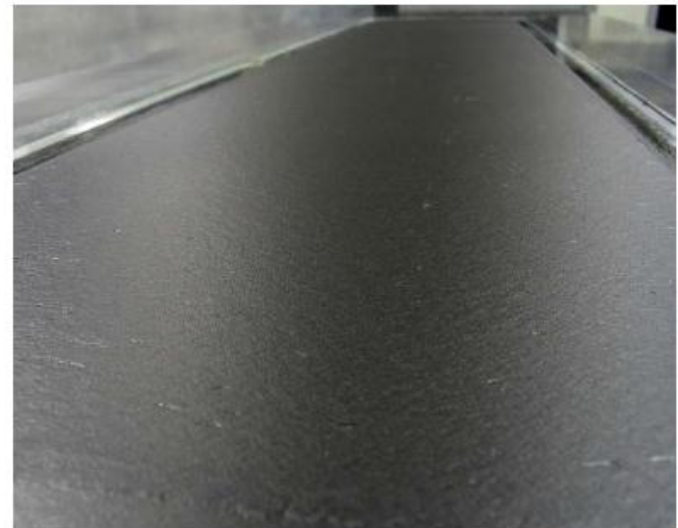
NACO 2: Non-conventional Matrix/Carbon Nanotube Reinforced Composites for Applications in Space, GSTP, (2011-2013). (Follow-on activity)



:FutureCarbon



University
of Patras



The main objectives of this project are: CNT-skeletons stabilization, optimization of the manufacturing processes and scale-up (CNT “sheets” with 1000x100m²).

CFRP composites with CNT based matrix



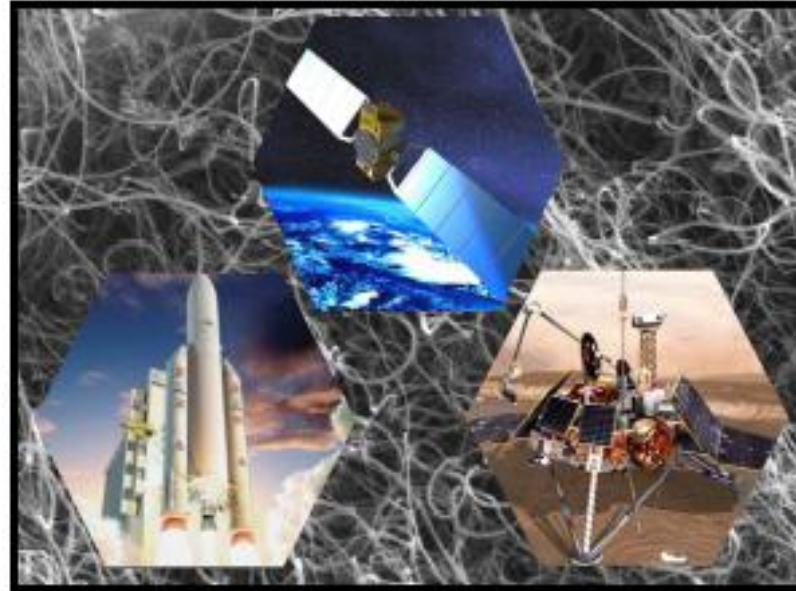
COPE: Composite Materials for Payload and Platform Elements, (2008-2010), ARTES 5 Program



NAREMA: Nanotube Reinforced Structural Materials for Spacecraft Applications, ESA Contract (2010-2012), TRP study

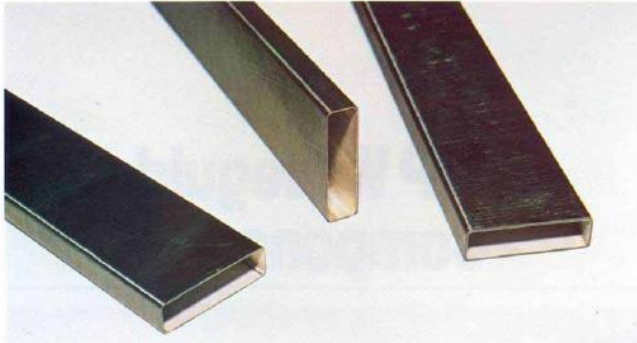


CFRP composites with CNT based matrix



The main objective of these projects is to produce **multiscale and multifunctional carbon fiber reinforced composites (CFRP) incorporating carbon nanotubes** for improved properties - mechanical, thermal and electrical properties – for payload and platform elements (**COPE**) and for spacecraft and launcher structures (**NAREMA**).

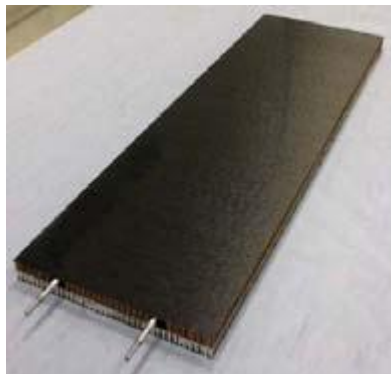
CFRP composites with CNT based matrix: examples of applications



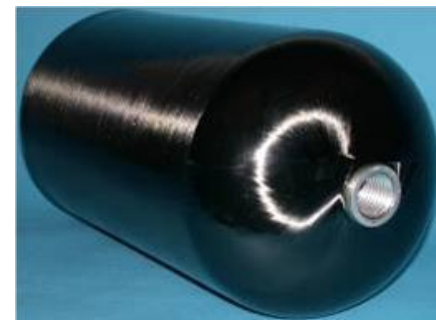
Waveguides



Reflectors for Antennas



Radiators and pure CFRP sandwich panels



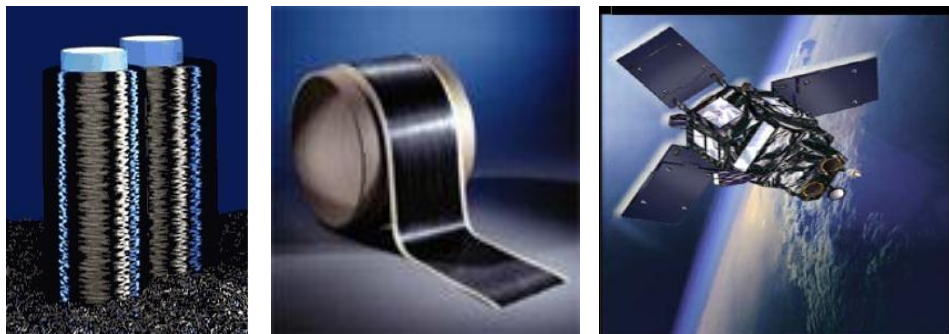
Tanks

CFRP composites for satellite sub-systems

Ku-DGR: Dual-Gridded Carbon Fibre Reinforced Plastic Reflector, ESA Contract, ARTES5.1 Program, (2011-2012)



The main objective is to develop a new Reflector concept for telecommunication satellites with a **CFRP rod based front and rear grid** for Ku-band applications. It is a follow-on project of a TRP lead by HPS Germany. **Key development is the manufacturing processes for the shaped rods.**



EUCARBON: European Space Qualified Carbon Fibres and Pre-impregnated Based Materials (Starting date: 1/12/2011; 36months; 2M€ funding)

Type of Funding scheme: Medium-scale integrating collaborative projects
Work program topics addressed: FP7-SPA.2011.2.2-02 Space critical technologies



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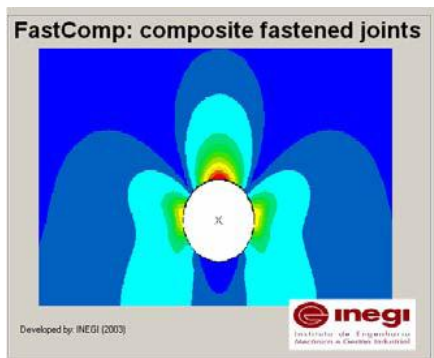
EUCARBON: Consortium



Software for Structural Integrity Analysis

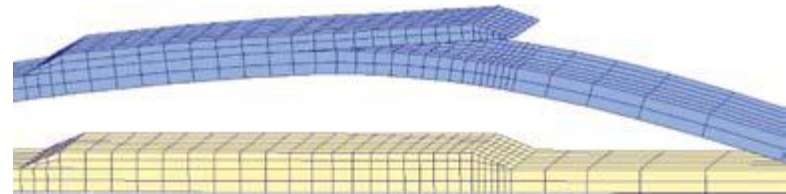
(Principal Investigator: Pedro Camanho)

Software for design of composite bolted joints and new models to predict fracture in advanced composite materials



FASTCOMP

A standalone utility to aid the design composite bolted joints and predict joint strength. Procedure developed under European Space Agency Contract.



New models

Development of new constitutive equations to predict damage onset and growth in advanced composite structures.

Thank you very much for your attention!

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