B6 Advanced Structure Design for Future Aircraft

Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures

ECO-COMPASS

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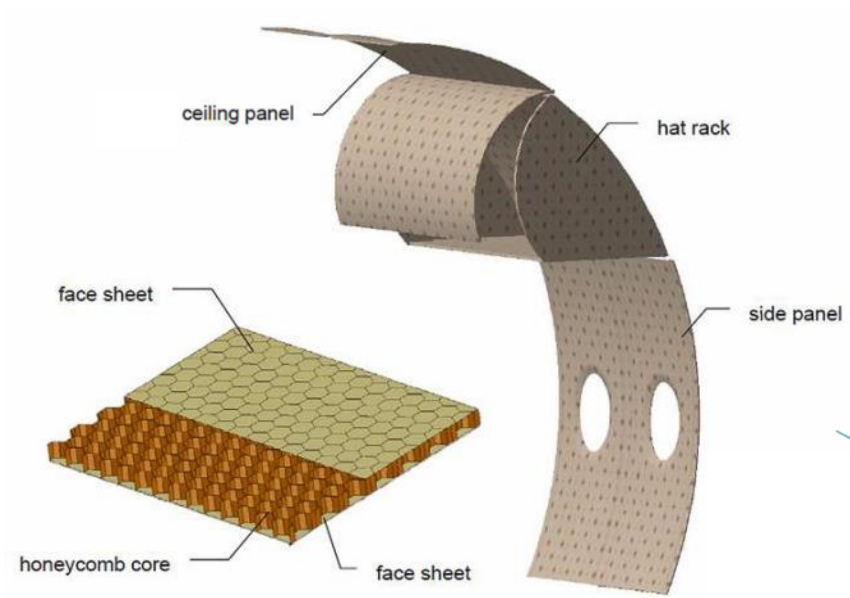
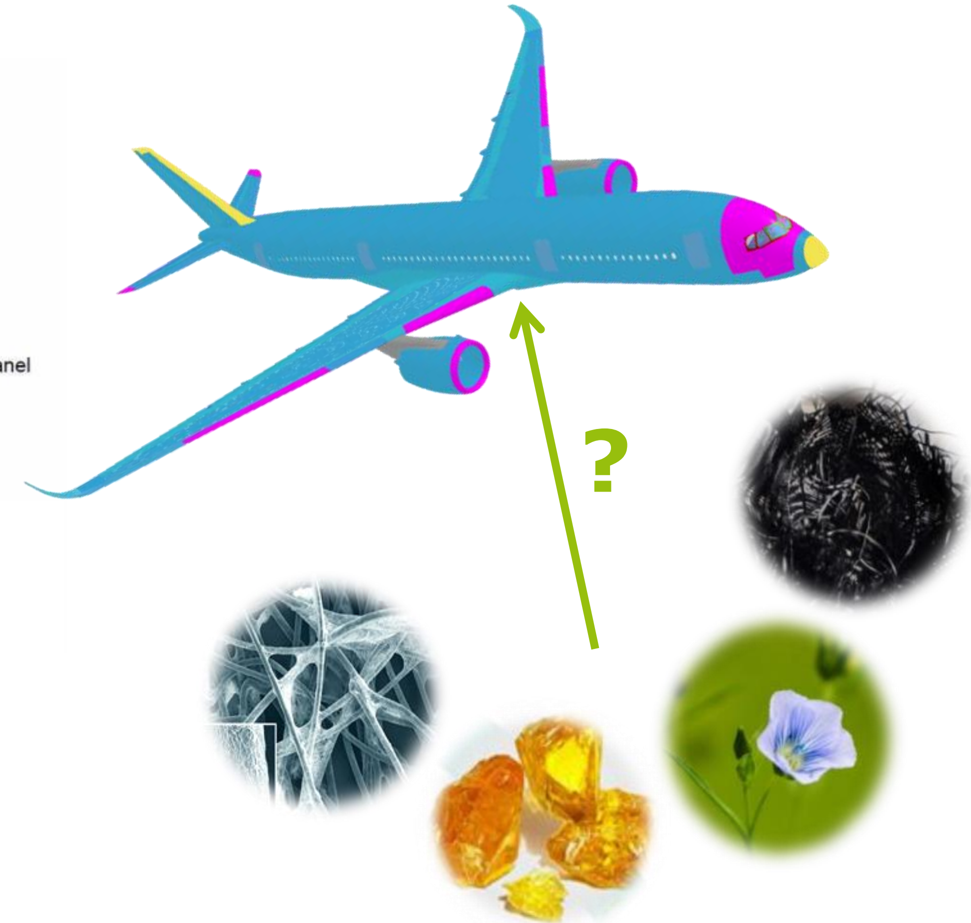
Scientific & technical goals





- Natural Fibres?
- Bio-based resins?
- Recycled fibres?
- Multifunction?

ECO-COMPASS

8

EUROPEAN PARTNERS

FROM 6 COUNTRIES

11

CHINESE PARTNERS

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Bucharest, 27-30 May 2019

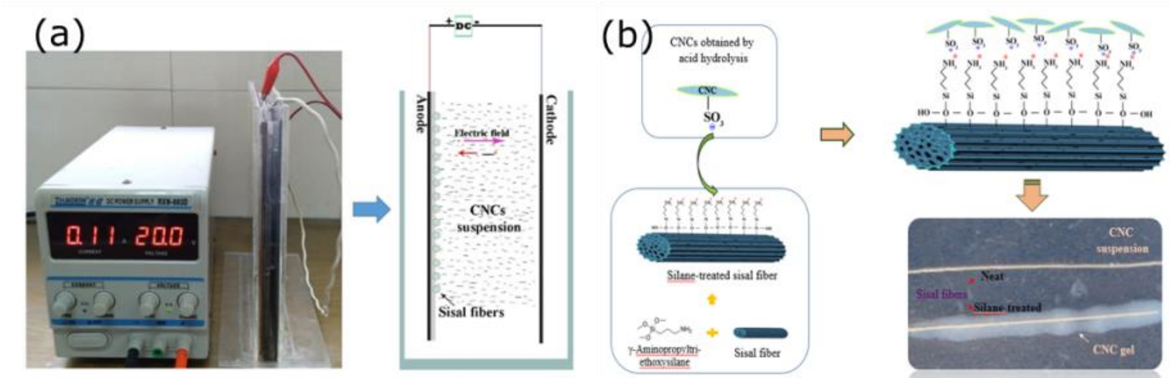
Scientific & technical goals

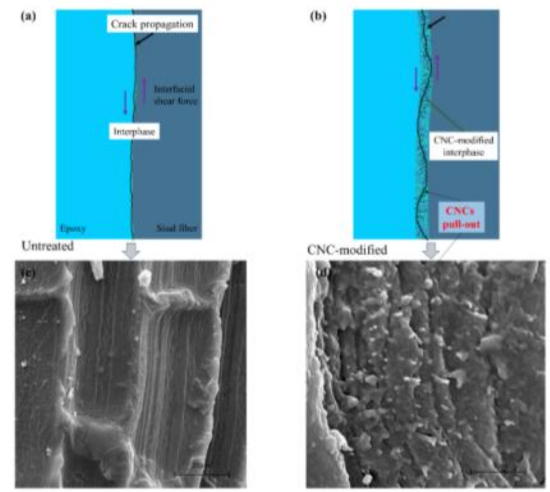
- *ECO-COMPASS*
  - **Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures**
- *Cooperation of Chinese and European partners*
- *2016 – 2019*

- *Identification of applications for eco- and multifunctional composites*
- *Development, characterization and simulation of eco-materials to give a broad overview of the possibilities in aviation with leverage to other transport sectors like automotive and railway*
- *Application / Demonstrators*
- *Life Cycle Assessment (LCA)*

Main achieved and expected results

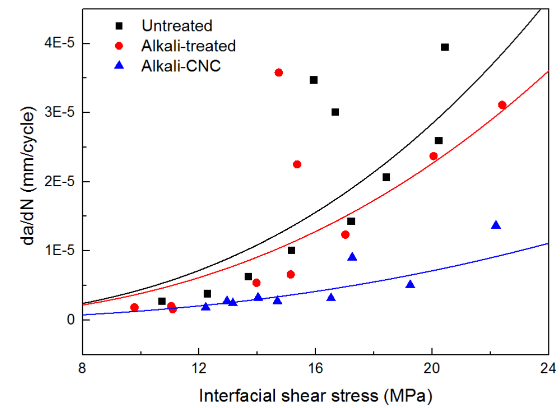
- *Improvement of fibre properties*





Modification of sisal fiber with CNC by (a) electrophoresis, (b) electrostatic adsorption

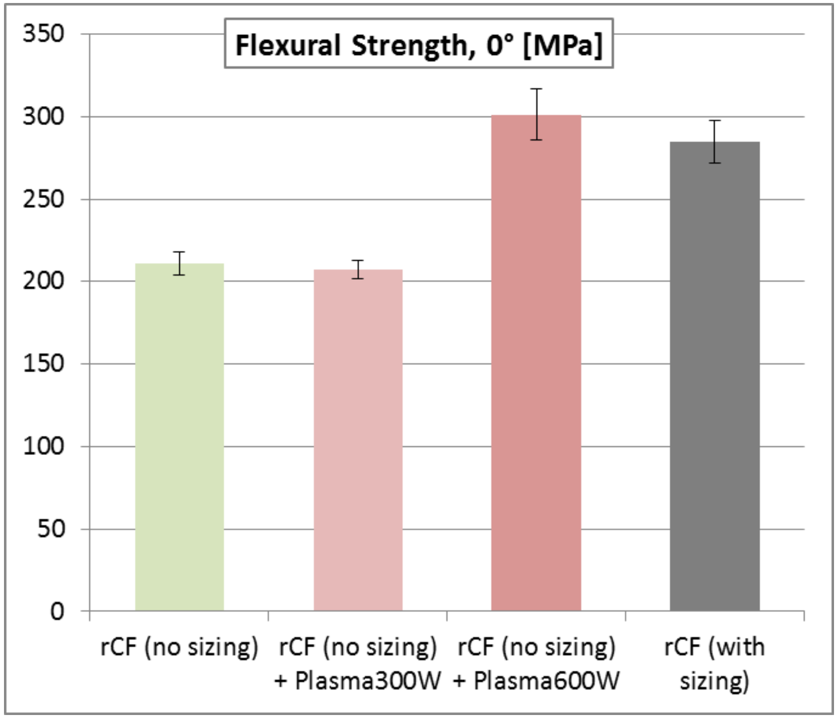
Treatment	Diameter (µm)	Tensile strength (MPa)	Young's Modulus (GPa)
Untreated	173.3 (31)	529.9 (102)	13.6 (2.9)
CNC-treated	175.3 (32)	511.5(97)	14.4 (3.3)
Alkali-treated	142.6 (18)	692.8 (92)	18.8 (3.0)
Alkali-CNC-EPD	156.4 (23)	614.9 (73)	22.0 (3.1)
Alkali-CNC-ESA	150.2 (20)	716.6 (110)	21.0 (2.6)



Li Y, Yi X, Yu T, Xian G, An overview of structural-functional-integrated composites based on the hierarchical microstructures of plant fibers, Advanced Composites and Hybrid Materials, 2018, 1(2), 231-246

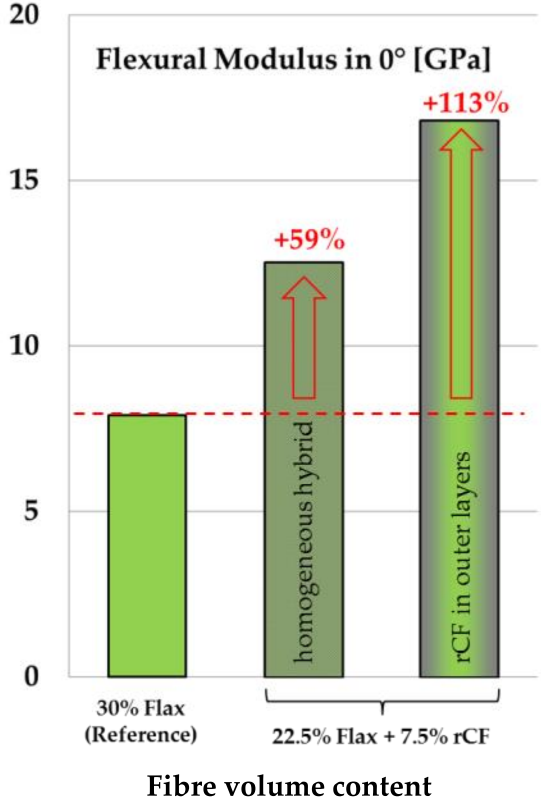
Main achieved and expected results

Plasma treatment (rCF, flax)



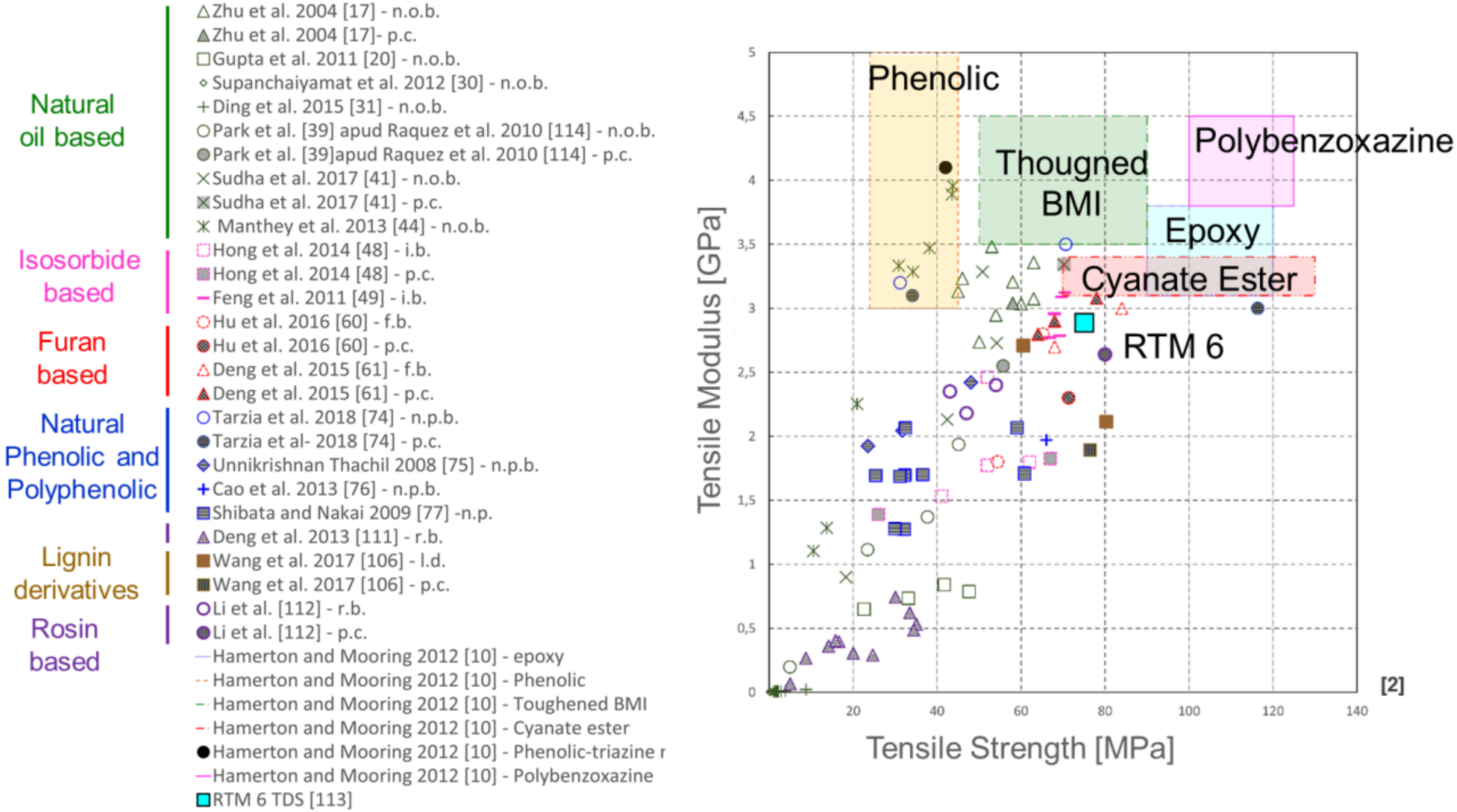
Techtextil 2019 forum, TTF 9 - sustainable fibre innovations & applications: "Plasma treatment of bio-based and recycled fibres for eco-composites", R Garcia, LEITAT

Hybrid nonwoven (rCF, flax)



Aerospace 2018, 5(4), 107; https://doi.org/10.3390/aerospace5040107
Aerospace 2018, 5(4), 120; https://doi.org/10.3390/aerospace5040120

Main achieved and expected results



Ramon, E.; Sguazzo, C.; Moreira, P.M.G.P. A Review of Recent Research on Bio-Based Epoxy Systems for Engineering Applications and Potentialities in the Aviation Sector. *Aerospace* 2018, 5, 110

Main achieved and expected results

- *Rosin-based curing agent epoxy resin*

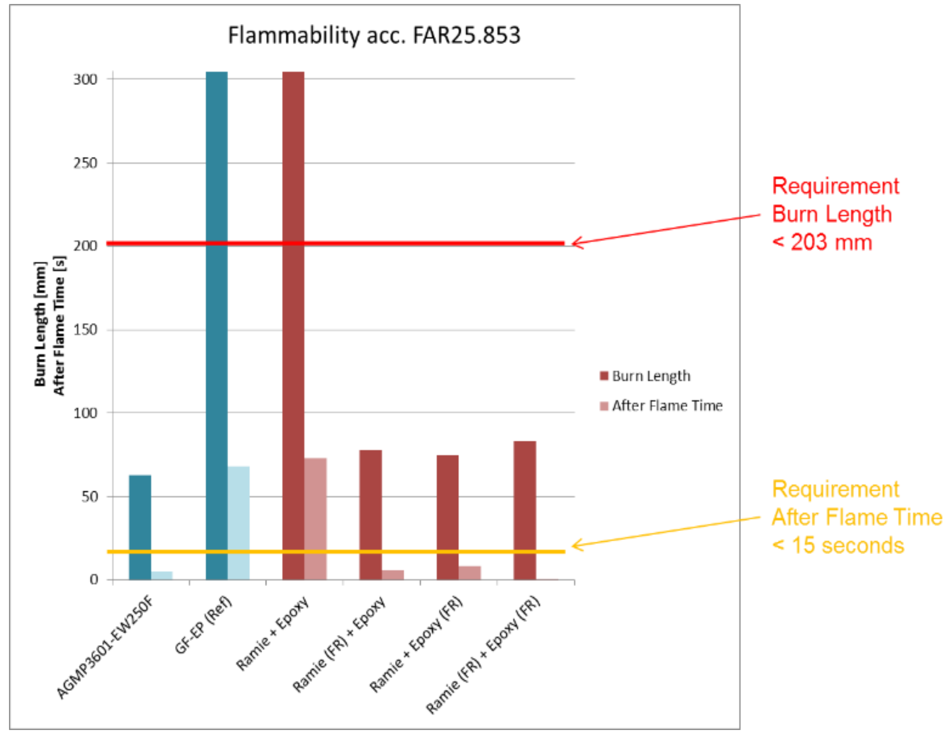
Property and test condition		Unit	Reference[1]	Test result	Standard
Tensile strength warp	RT/dry	MPa	≥500	707	ASTM D 3039
Tensile modulus warp	RT/dry	GPa	65±8	62.3	
Tensile strength weft	RT/dry	MPa	≥500	557	
Tensile modulus weft	RT/dry	GPa	65±8	60.9	
Compression strength warp	RT/dry	MPa	≥300	509	ASTM D6641
Compression modulus Warp	RT/dry	GPa	58±8	61.2	
Compression strength Weft	RT/dry	MPa	≥280	362	
Compression modulus weft	RT/dry	GPa	57±8	57.7	
Bending strength warp	RT/dry	MPa	≥650	883	ASTM D 790
Bending modulus warp	RT/dry	GPa	58±8	56.8	
Short bean shear strength	RT/dry	MPa	≥50	55.7	ASTM D2344
In plane shear strength	RT/dry	MPa	≥45	72.6	ASTM D3518
In plane shear modulus	RT/dry	GPa	3.5±1	3.84	

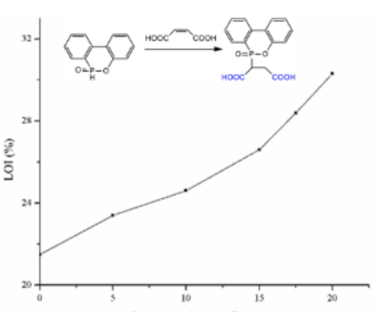
[1] A commercial product

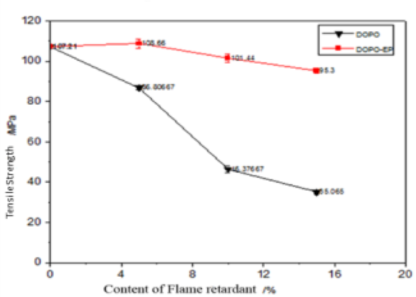
Aerospace 2018, 5(2), 65; https://doi.org/10.3390/aerospace5020065
Aerospace 2018, 5(4), 110; https://doi.org/10.3390/aerospace5040110

Main achieved and expected results

- *Flammability*



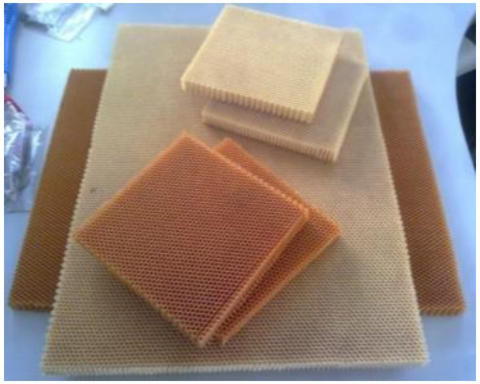


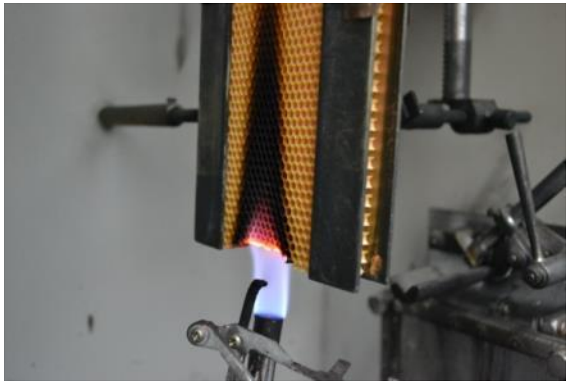


Main achieved and expected results

AGMH-1 "Green Honeycomb" is made of plant fiber hybrid paper containing 20% plant fibers.

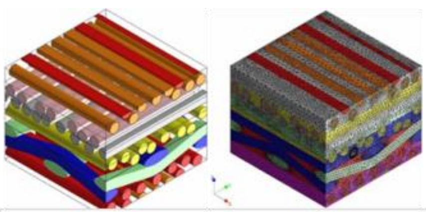
Items	Compression strength, MPa	Longitudinal shear strength, MPa	Transversal shear strength, MPa	Longitudinal shear modulus, MPa	Transversal shear modulus, MPa
Nomex, I	1.24	1.0	0.55	32.5	19.5
Nomex, II	1.64	1.07	0.58	36	19
GREEN Honeycomb	1.78	1.16	0.75	43.2	29.3

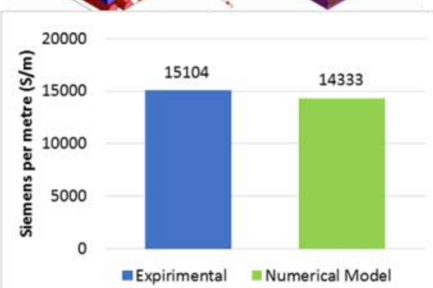


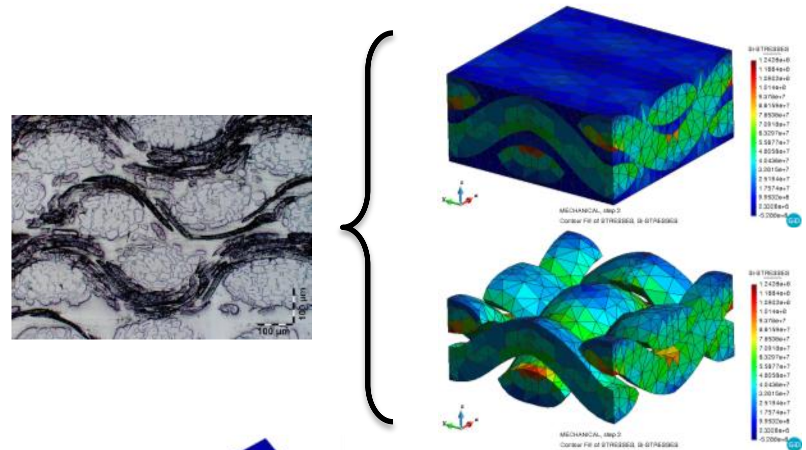


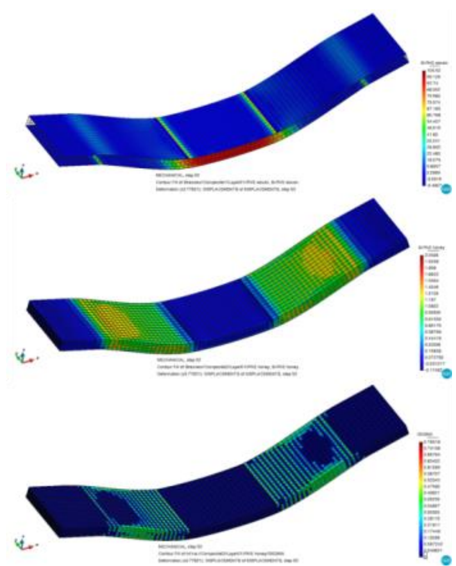
Main achieved and expected results

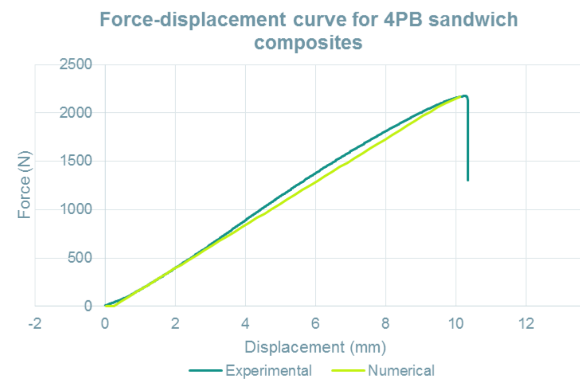
- *Modelling*







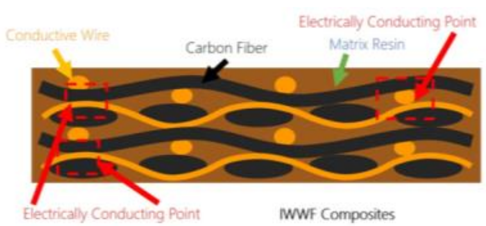


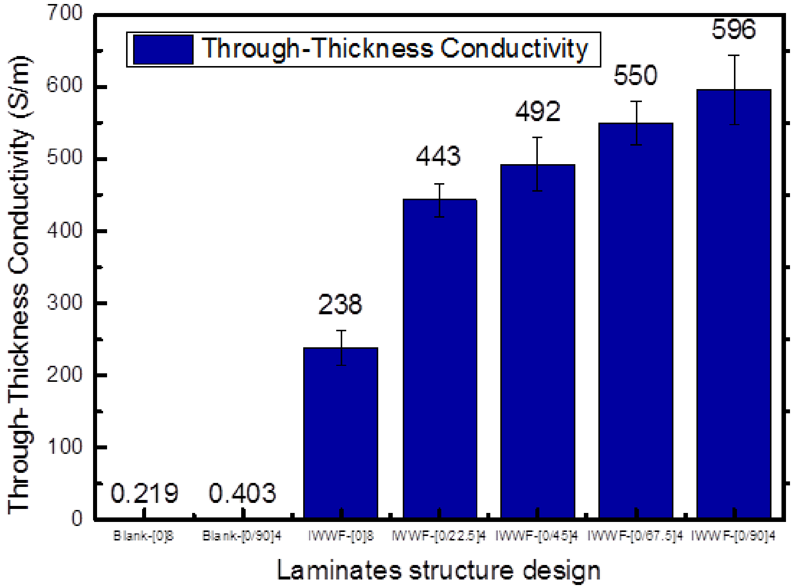


Composite Structures 131 (2015): 707-719. DOI: 10.1016/j.compstruct.2015.06.006
Composite Structures 206 (2018): 215-233. DOI: 10.1016/j.compstruct.2018.08.022

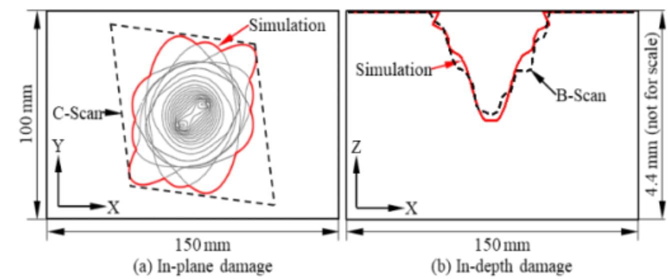
Main achieved and expected results

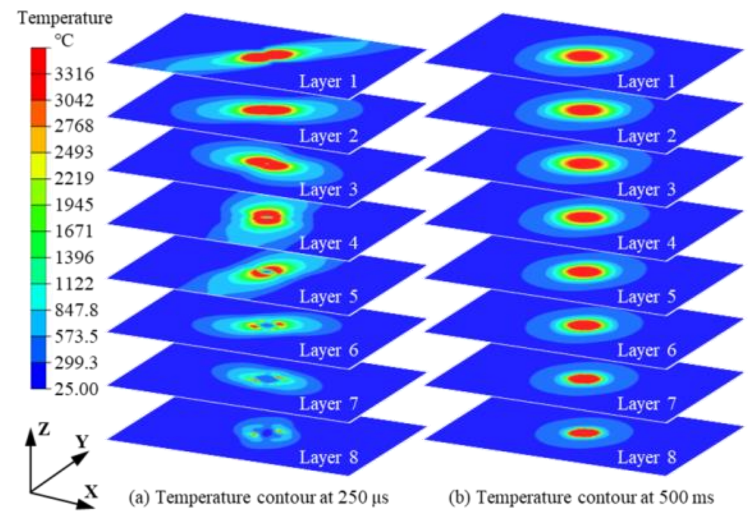
Electrical Conductivity Integration via InterWoven Wire Fabrics (IWWF)





Damage analysis CFRP lightning





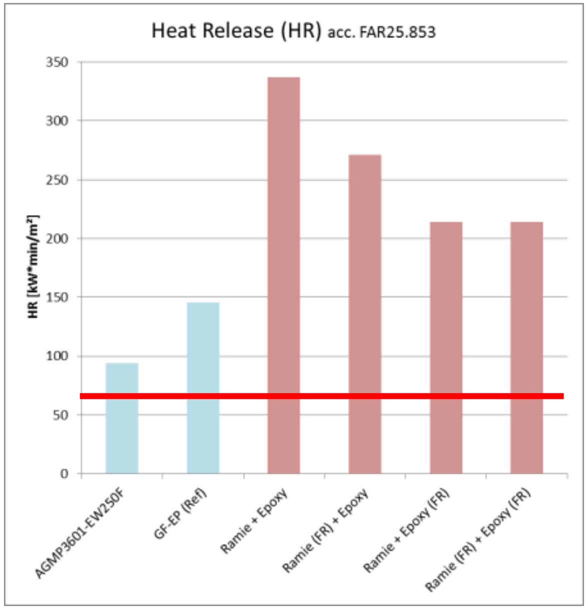
Dong Qi, Wan Guoshun, Guo Yunli, Zhang Leian, Wei Xiuting, Yi Xiaosu, Jia Yuxi. Damage analysis of carbon fiber composites exposed to combined lightning current components D and C. ***Composites Science and Technology***, 179 (**2019**): 1-9

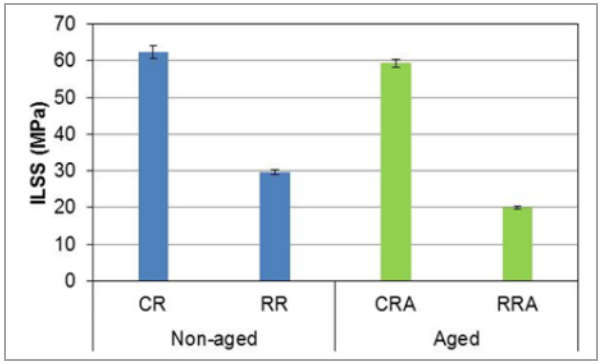
Potential gaps and challenges

- *Fire resistance, especially the Heat Release of NFRP and (bio-based) epoxy resins.*

- *Long term behaviour*

- *Assessment of potential environmental impacts of treatments and processes to improve properties of eco-composites*



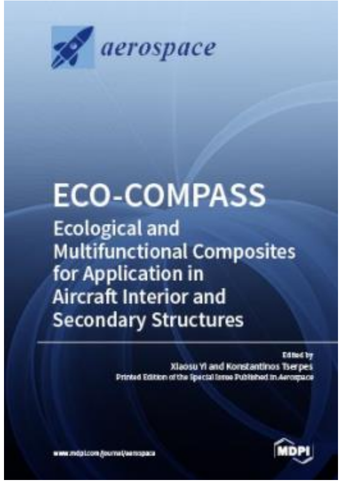


Cross-cutting issues (tech. & non-tech.)

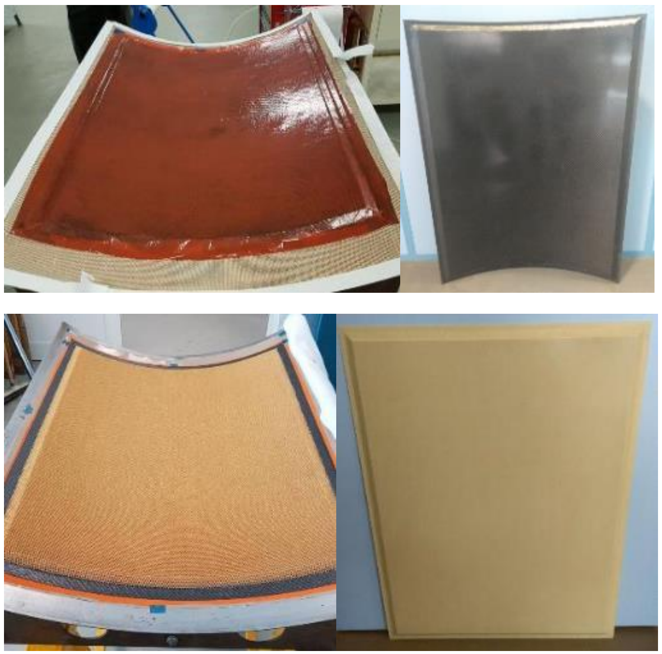
- *Enhanced links between the European and Chinese entities contributing to the European initiatives in international cooperation*
- *Many open access publications which made the project data management "FAIR" (findable, accessible, interoperable and re-usable)*
- *Potential reduction of environmental impacts (e.g. global warming) during all life cycle phases*
- *Bio-based fibres and resins systems are promising materials for eco-composites in other transport sectors and industries. Successful use in demanding aviation could lead to increased use in other application areas*

Impacts

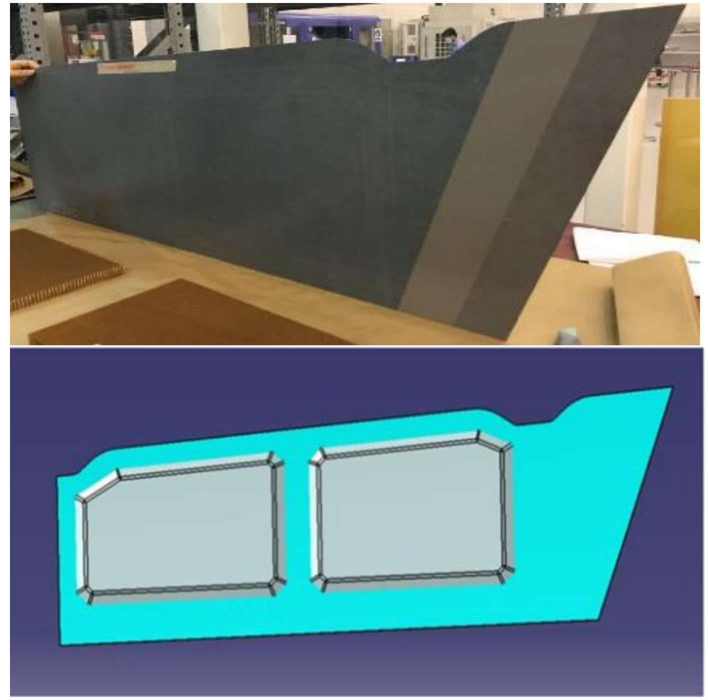
- *Reduction of environmental footprint by substitution of synthetic composite materials with bio-based and recycled materials.*
  - **Raw materials (and processes)**
  - **Fuel consumption during use-phase / lower density and multifunctional aspects.**
  - **End-of-Life recycling and energy recovery options**
- *Numerous publications, conference sessions and news articles*
  - **Special Sessions (ICCS, ICGC)**
  - **SCTS and Aerospace Special Issue (book)**
  - **Euronews „futuris" film**



Demonstrators



Airbus



AVIC

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