ECO-COMPASS EU/CHINA PROJECT: STATUS AND OUTLOOK ON ECOLOGICAL IMPROVED COMPOSITES FOR AVIATION INTERIOR AND SECONDARY STRUCTURES

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Jens Bachmann* (DLR)

YI Xiaosu* (AVIC BIAM)

*) Coordinators of the ECO-COMPASS project

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- The Ministry for Industry and Information of the People's Republic of China under grant agreement No [2016]92

Content

- Background
- Aims
- Applications
- Involved partners from China & Europe
- Work Structure
- Challenges for eco-materials
- Status and chosen results
- Outlook

Background

- Aircraft configuration
- Propulsion / alternative fuels
- Aerodynamics
- Trajectory / flight path
- Energy management
- …
- Lightweight design
    - Fibre Reinforced Composites
        - CFRP, GFRP, GLARE, …

→ Synthetic / man-made materials

- **Natural Fibres?**
- **Bio-based resins?**
- **Recycled materials?**
- **Function Integration?**

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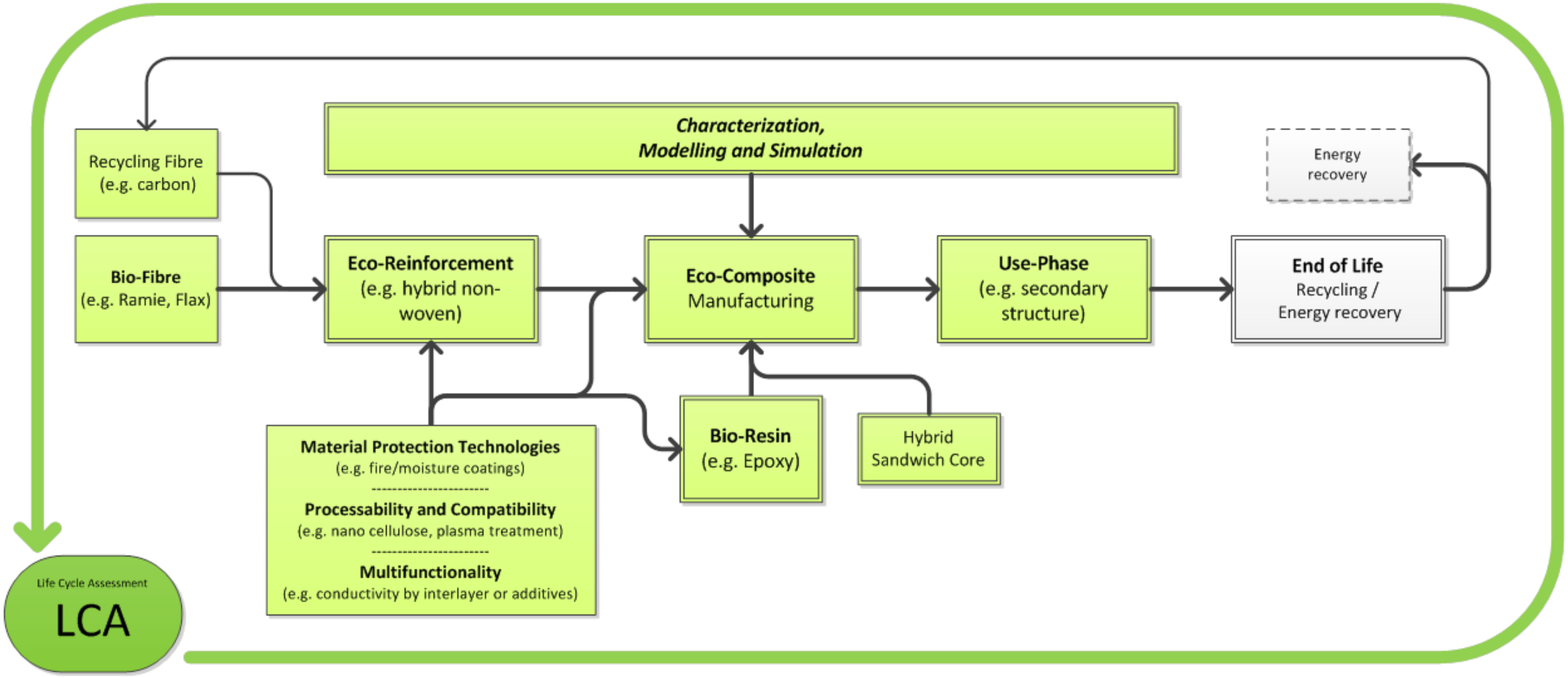
Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures

- Cooperation of Chinese and European partners
- 04/2016 – 03/2019

- 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)

ECO-COMPASS Approach



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8 EUROPEAN PARTNERS
FROM 6 COUNTRIES

11 CHINESE PARTNERS

AIRBUS
CIMNE
DLR
inegi driving science & innovation
UP
LEITAT Technological Center
MANCHESTER 1824 The University of Manchester
University of Patras Laboratory of Technology & Strength of Materials
中航工业北京航空材料研究院
航太
中航工业西安飞机工业(集团)有限责任公司
CNITECH
上海飞机制造有限公司 Shanghai Aircraft Manufacturing Co.,Ltd.
中航通用飞机有限责任公司
中航工业哈飞 AVIC HAIG
中航复合材料有限责任公司 AVIC COMPOSITE CORPORATION LTD

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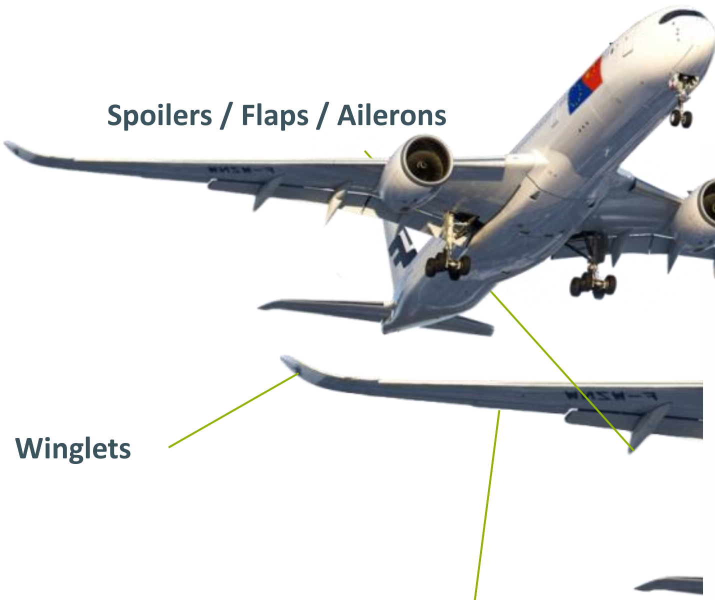
ECO-COMPASS Application



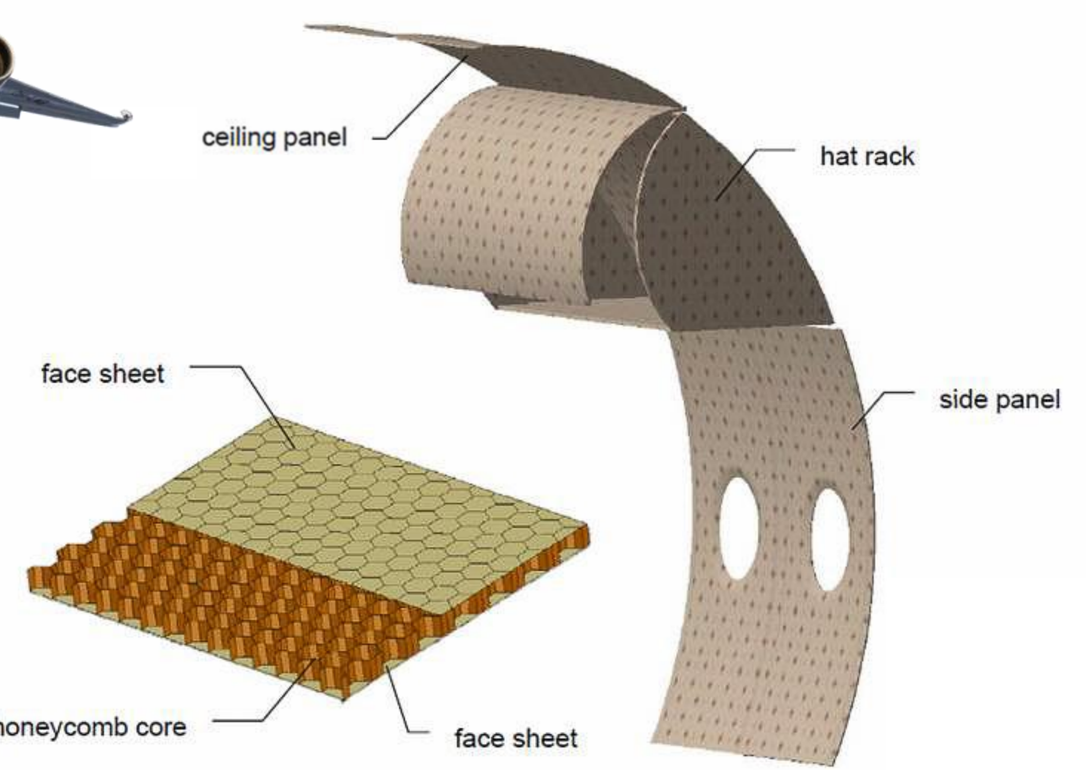
Spoilers / Flaps / Ailerons

/ Horizontal Stabilizer Fairings

Radome

Winglets

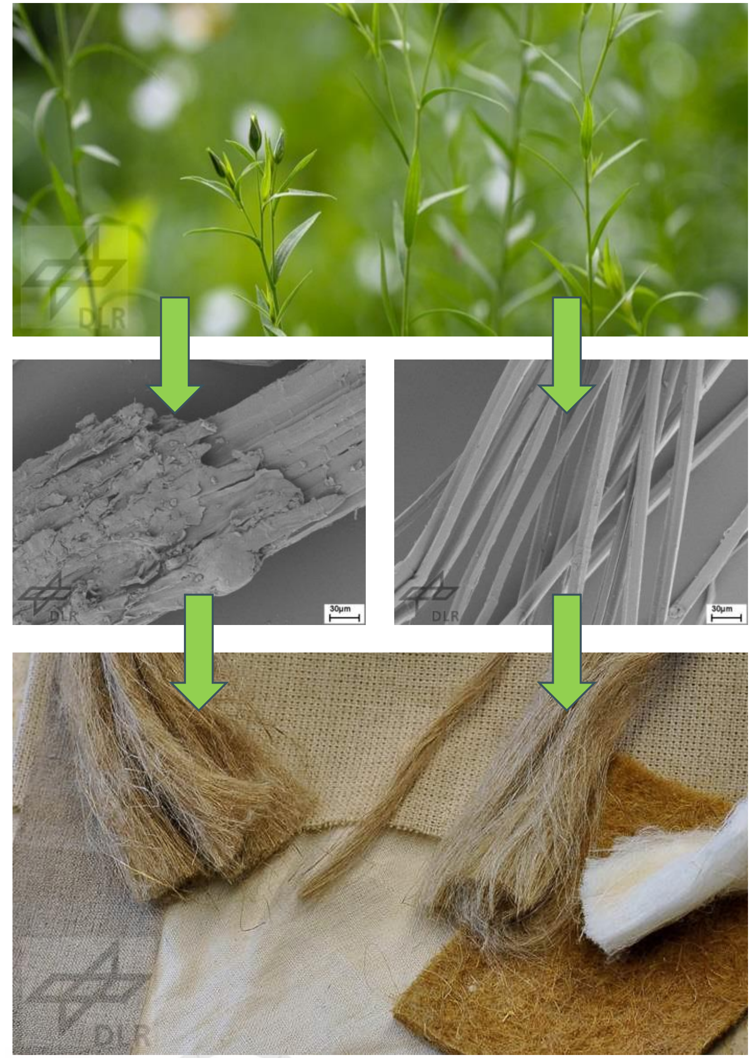
Trailing Edge Upper and Lower Panels



Main & Center Landing Gear Doors

Natural Fibres: Challenges

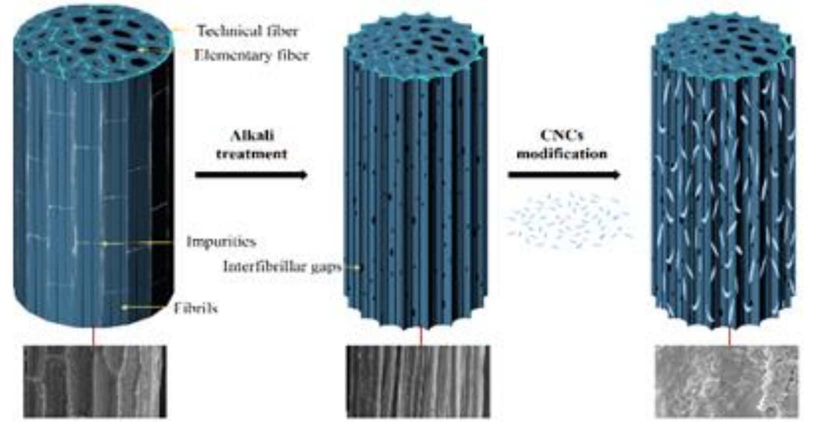
- Fulfillment of demanding requirements in aviation
  - Mechanical properties
  - Fire properties
    - Heat Release
    - Flammability
    - Smoke Density & Toxicity
    - Flame penetration resistance (Cargo)
- Variable fibre properties
- Durability (Resistance to climate, UV, cleaning agents)
- Modifications and their effects on environmental impacts
- Prediction of material behaviour by modelling and simulation



EXAMPLES FROM THE WORK IN PROGRESS

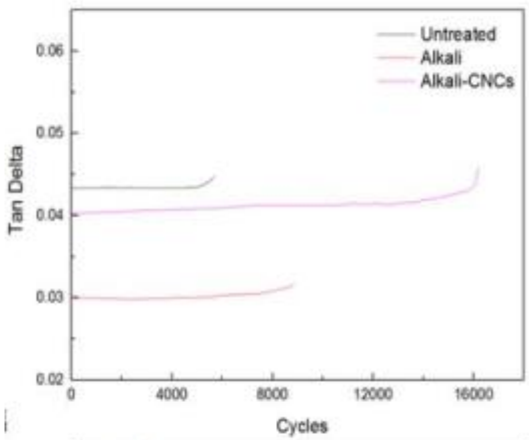
EU & China

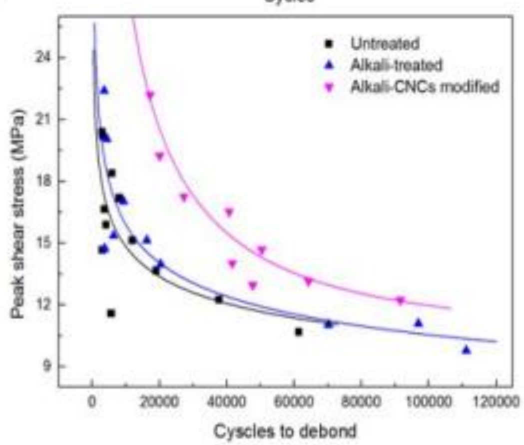
Reinforcements

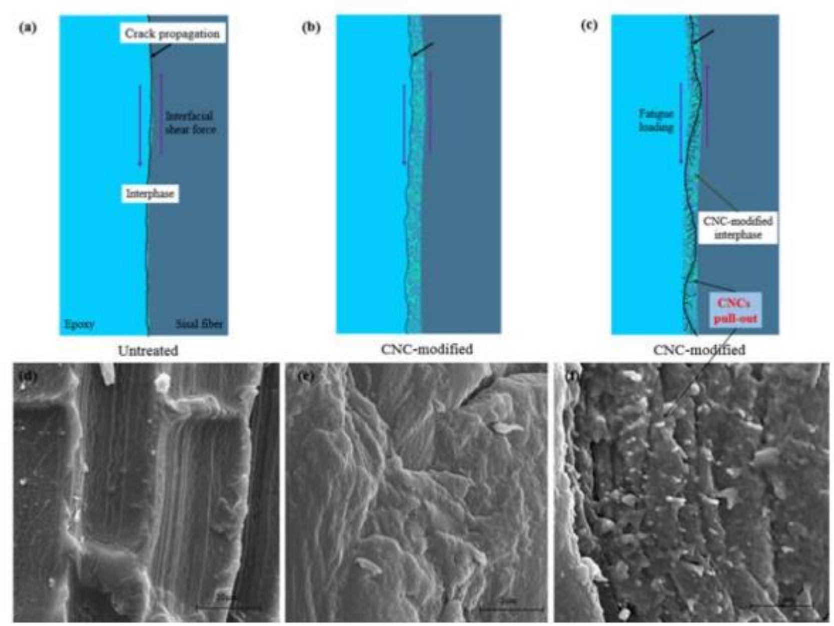


Mechanical properties of modified sisal fibers

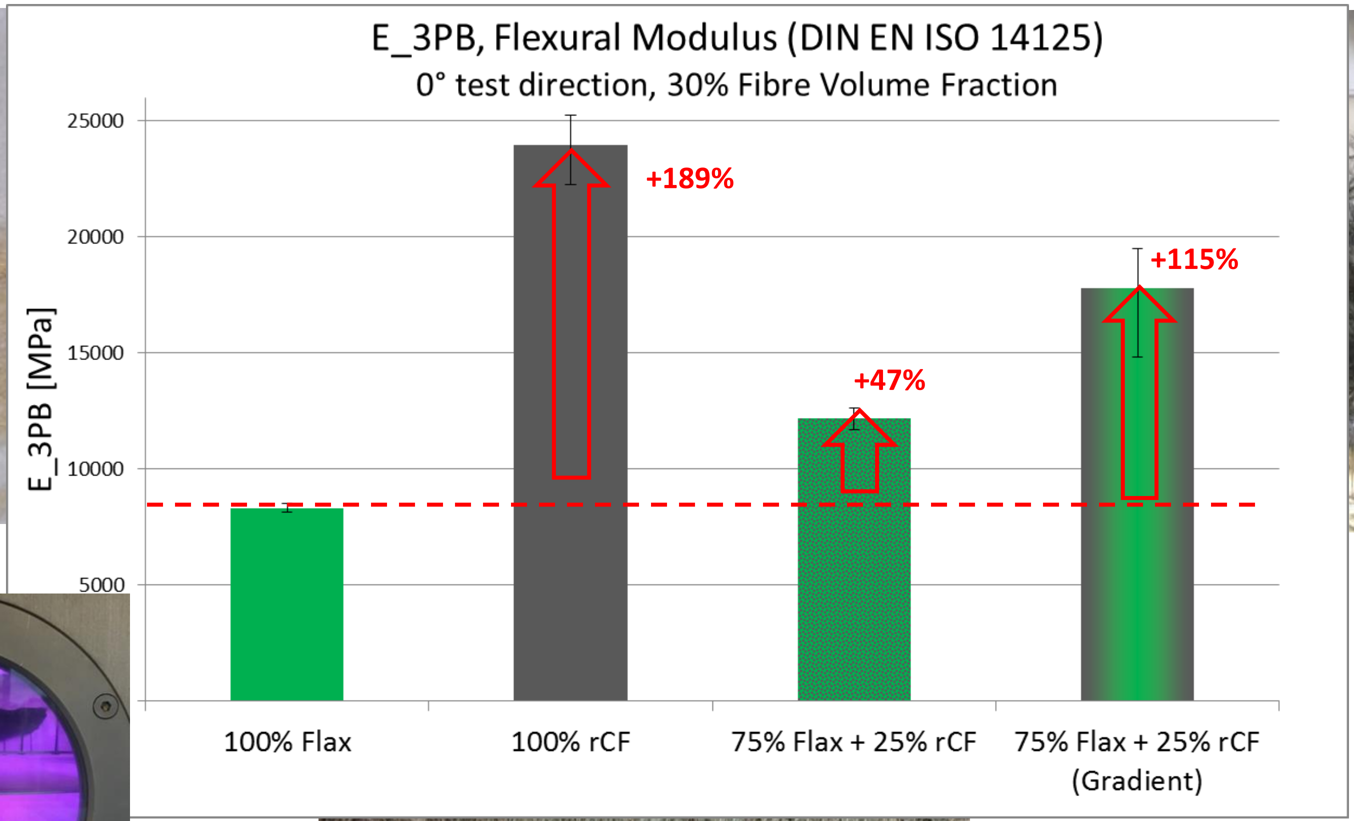
Treatment	Diameter (μm)	Tensile strength (MPa)	Young's Modulus (GPa)
Untreated	173.3	529.9 (102)	13.6 (2.9)
Alkali-treated	142.6	692.8 (92)	18.8 (3.0)
Alkali-CNCs-EPD	156.4	614.9 (73)	22.0 (3.1)
Alkali-CNCs-ESA	150.2	716.6 (110)	21.0 (2.6)

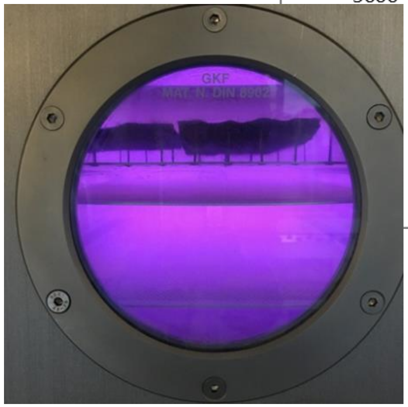






Reinforcements

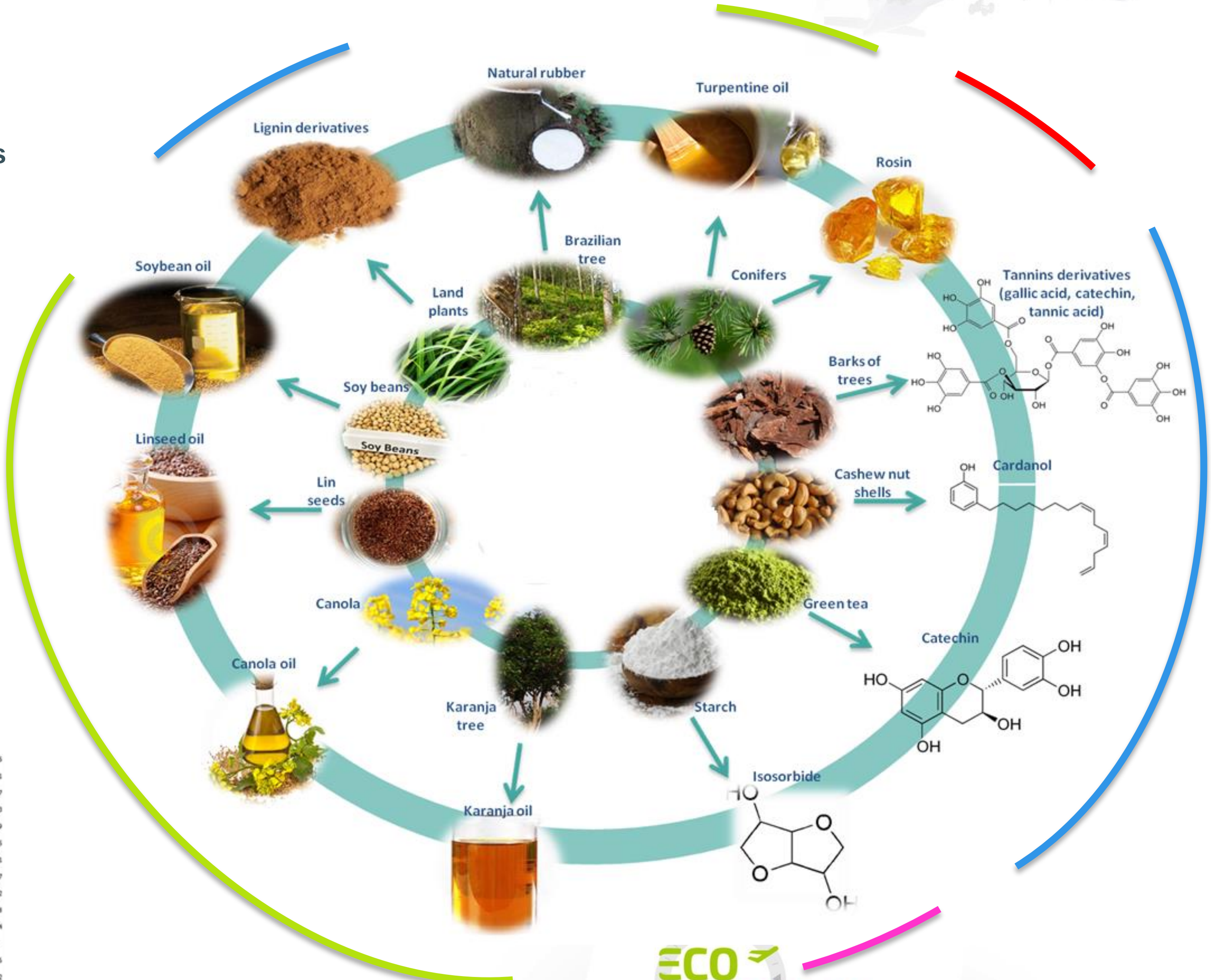


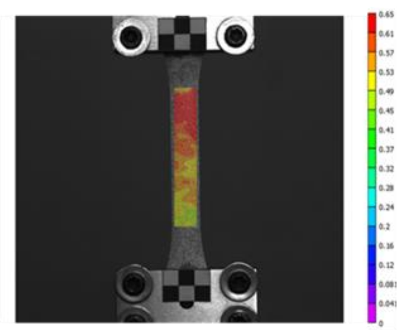


Plasma treatment?

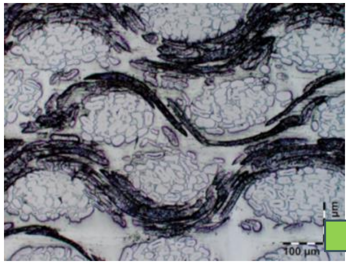
Resins

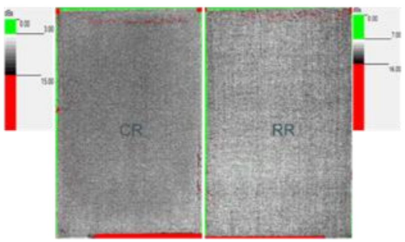
- Epoxidized natural oils
- Rosin
- Saccharides
- Natural polyphenols

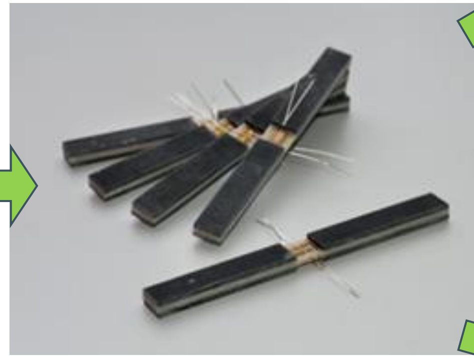


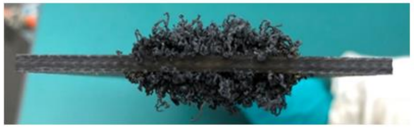


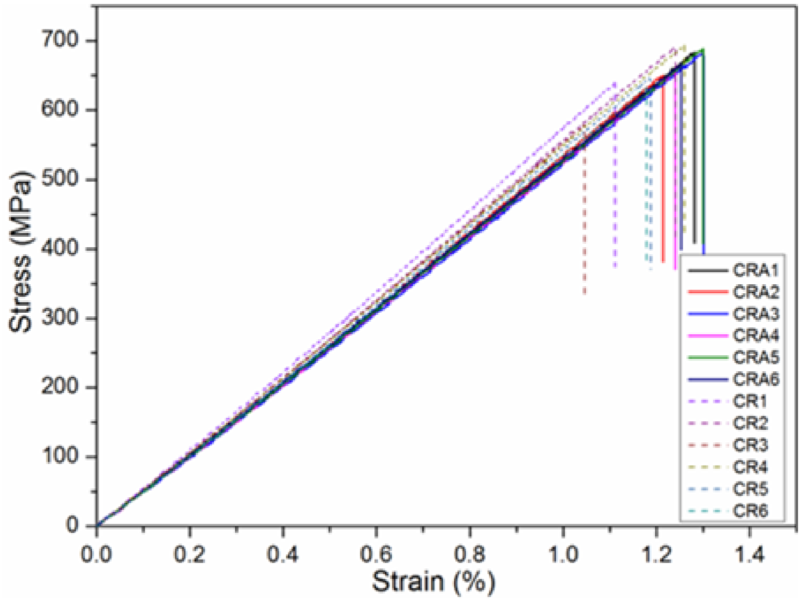
Characterization



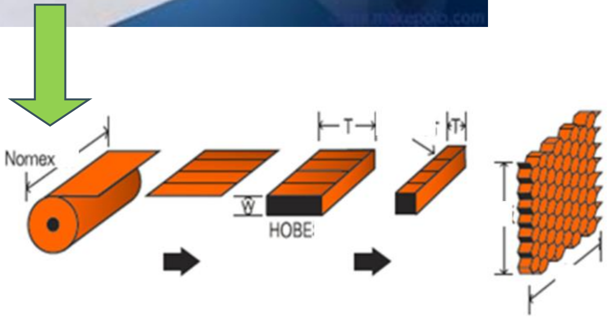


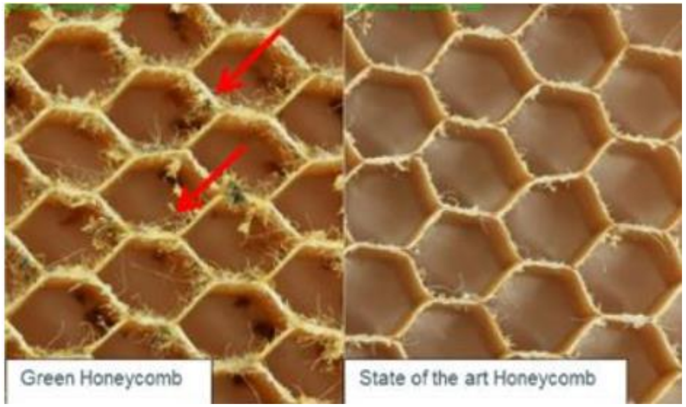


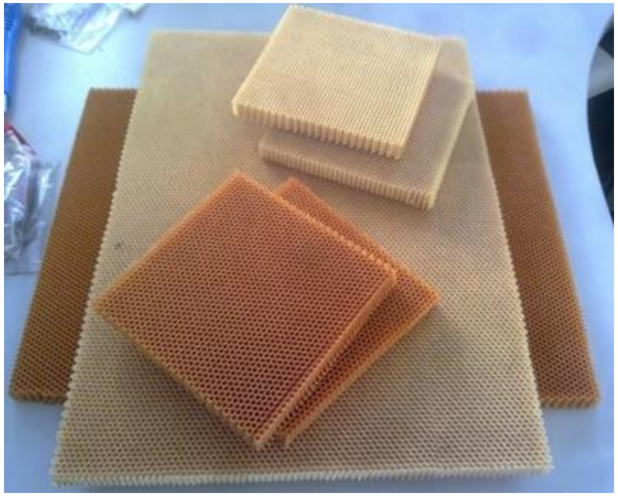




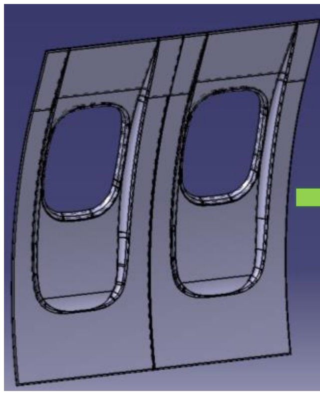
Honeycomb

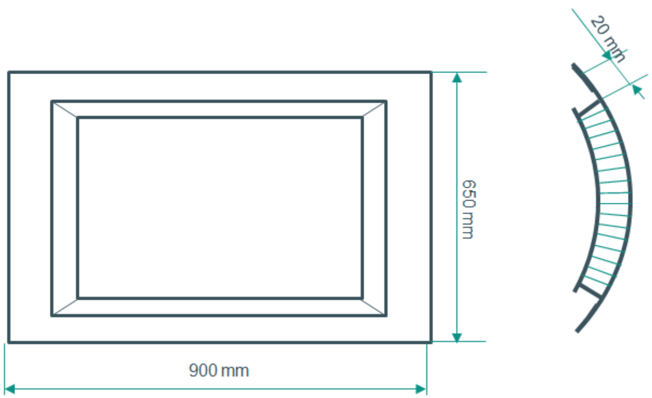


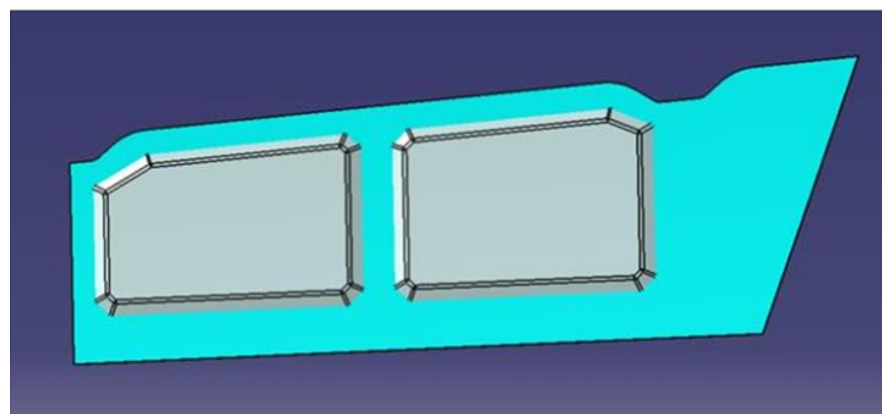




Demonstrators







Summary & Outlook

- Interior and Secondary Structures are possible application scenarios for eco-composites, e.g. fairings and linings.
- Demanding safety requirements (e.g. FST) have to be fulfilled without adverse effects on mechanical properties and weight
- Bio-fibres (e.g. flax, ramie) offer promising specific properties. Modifications of fibres to enhance their properties are under investigation (plasma treatment, nano-cellulose, etc.).
- Hybrid composites based on bio-fibres and recycled carbon fibres could increase the mechanical properties and application range of eco-composites
- Bio-based epoxy shows promising results comparable to petrol-based resins
- Multifunctional aspects of high-performance composites like CFRP could lead to a better ecological footprint.
- Modelling & simulation helps to predict the behaviour of eco-composites in demanding applications like aviation.
- Life Cycle Assessment (LCA) to calculate the environmental impact from cradle to grave is important to compare „eco-composites“ with state of the art materials

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THANK YOU FOR YOUR ATTENTION.

ECO-COMPASS SPECIAL SESSION AT ICGC-10

ICGC-10

The 10th International Conference on Green Composites

November 7-9, 2018 || Quanzhou, China

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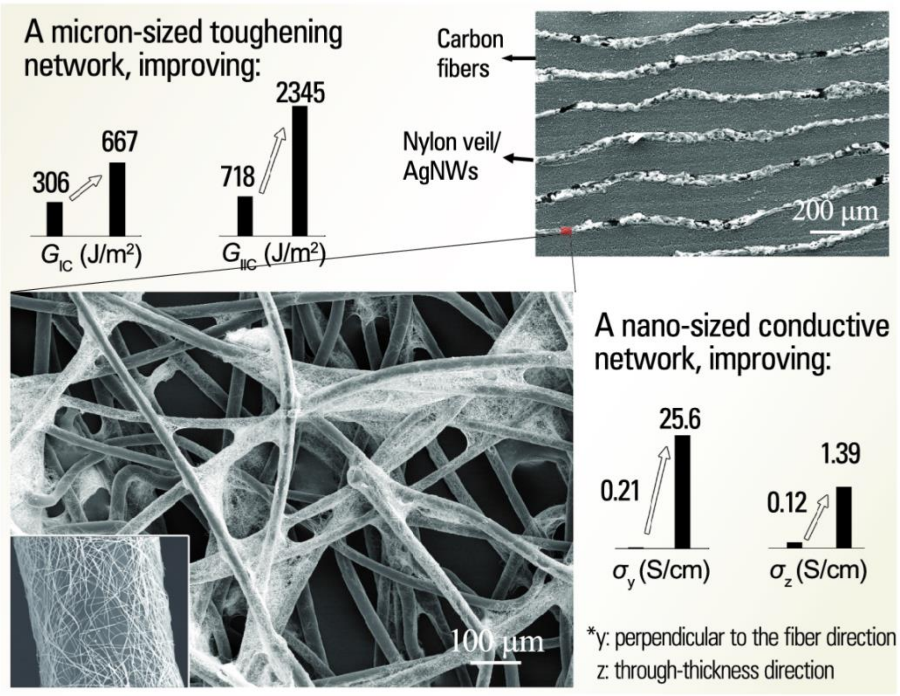
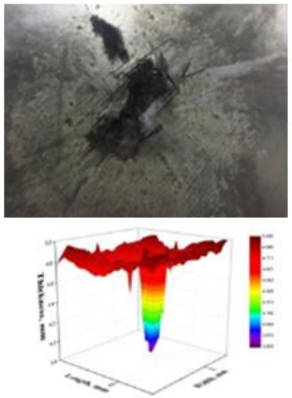
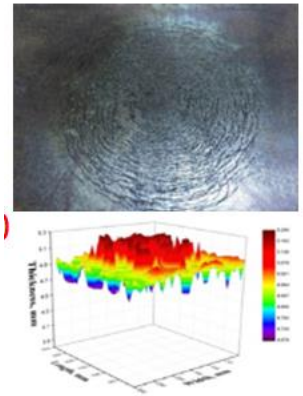
Multifunction

- Functionalized Interlayer Technology (FIT)





Control



FIT sample