

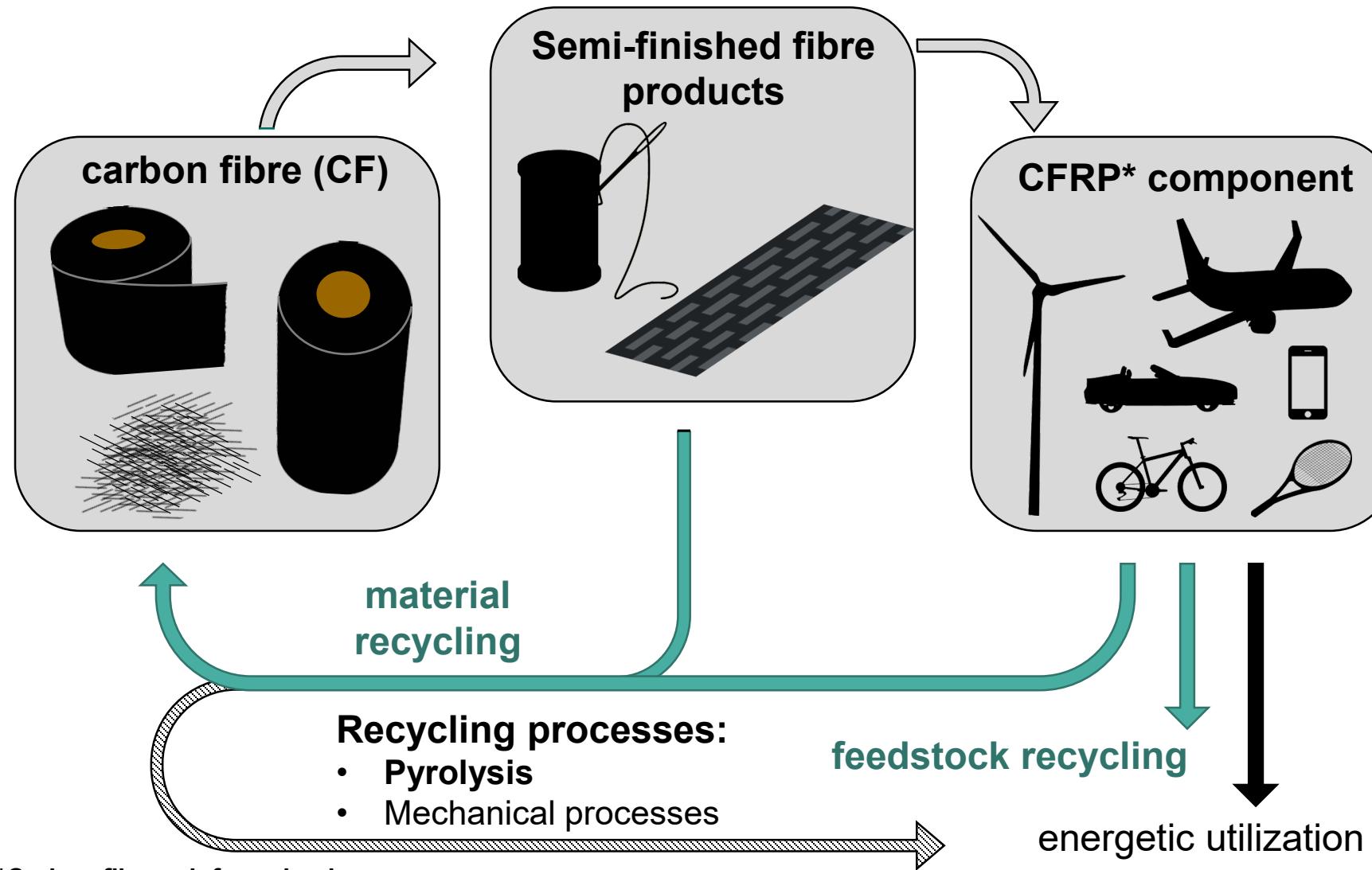
Characterisation of inhalable aerosols from carbon fibres

S. Mülhopt, M. Hauser, M. Wexler, J. Mahl, W. Baumann, S. Diabaté, S. Fritsch-Decker, C. Weiss, A. Friesen,
M. Hufnagel, A. Hartwig, B. Gutmann, C. Schlager, T. Krebs, A.-K. Goßmann, F. Weis, and D. Staph



KIT ITC 20210421 EXPO Versuch term. Faser

Life cycle of carbon fibres



*Carbon fibre reinforced polymer

Processing of CF/CFRP

includes:

- Mechanical processes like
 - Cutting
 - Sawing
 - Grinding
 - ...
- Thermal processes like
 - Energetic disassembly
 - Pyrolysis
 - ...

→ Change of properties possible
→ Release of fibres and fibre fragments possible



CFC – Carbon Fibre Cycle

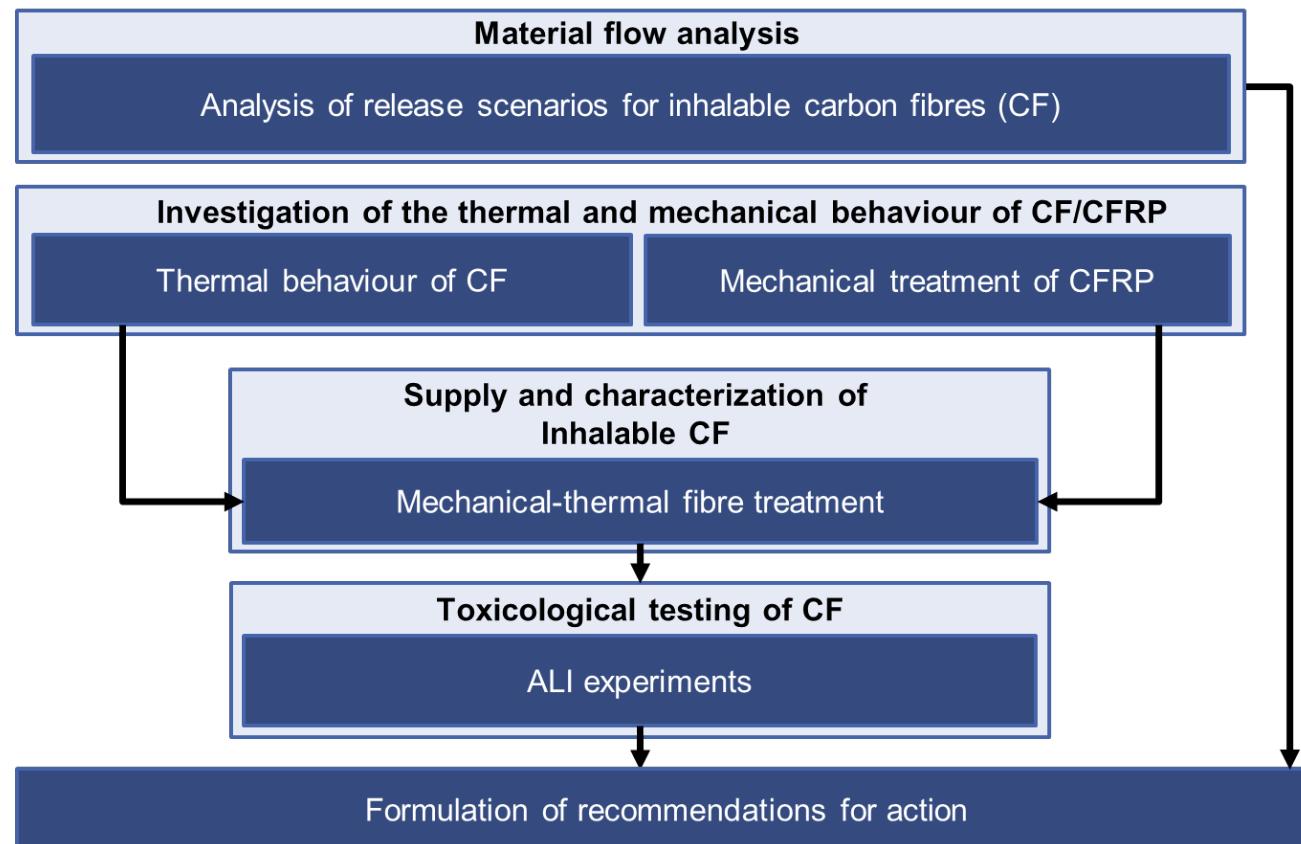
GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung

Durancé:
Grant nr.:

01.01.2019 – 30.06.2022
FK 03XPO195



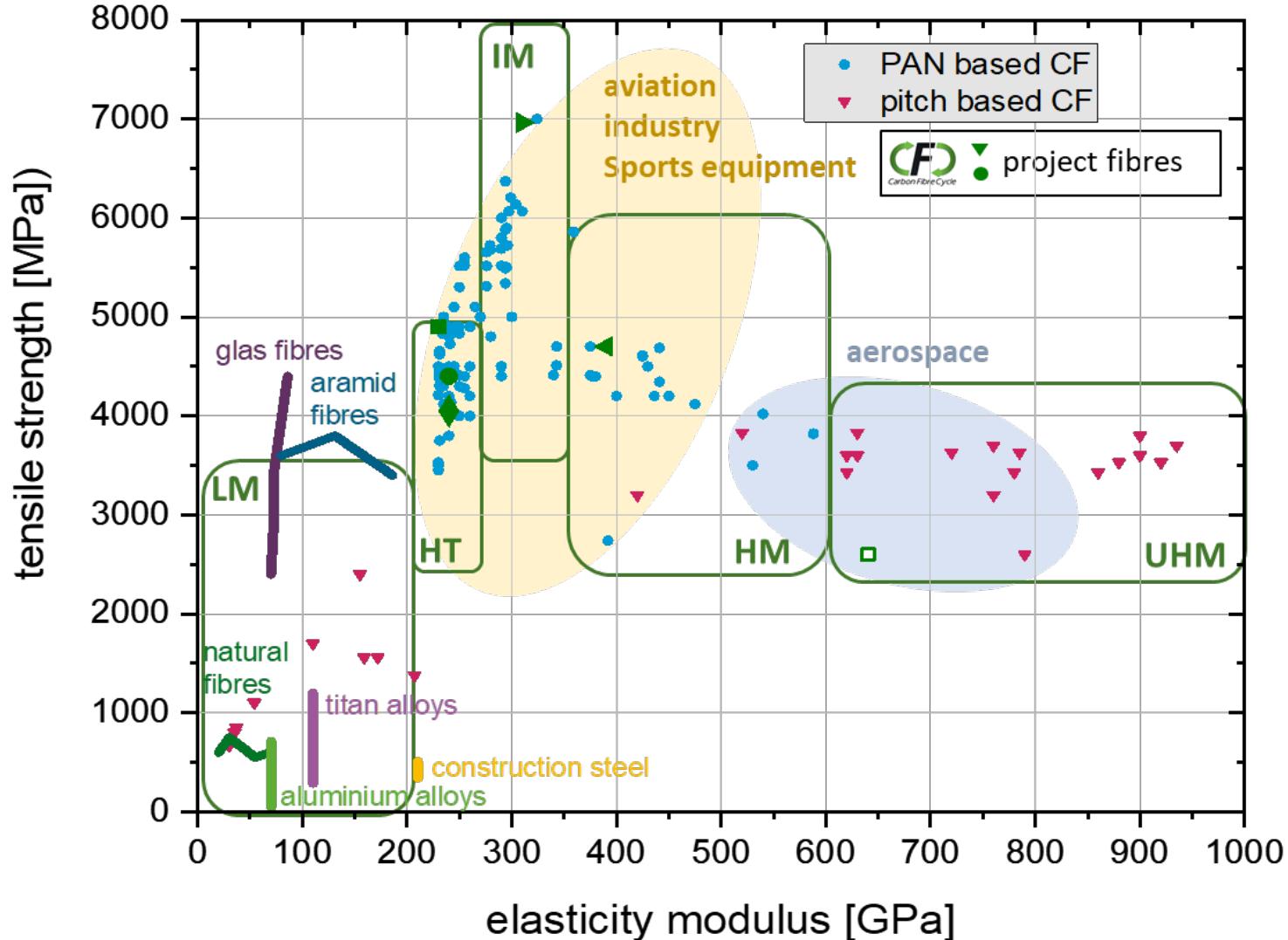
Karlsruhe Institute of Technology



Karlsruhe Institute of Technology



Carbon fibres

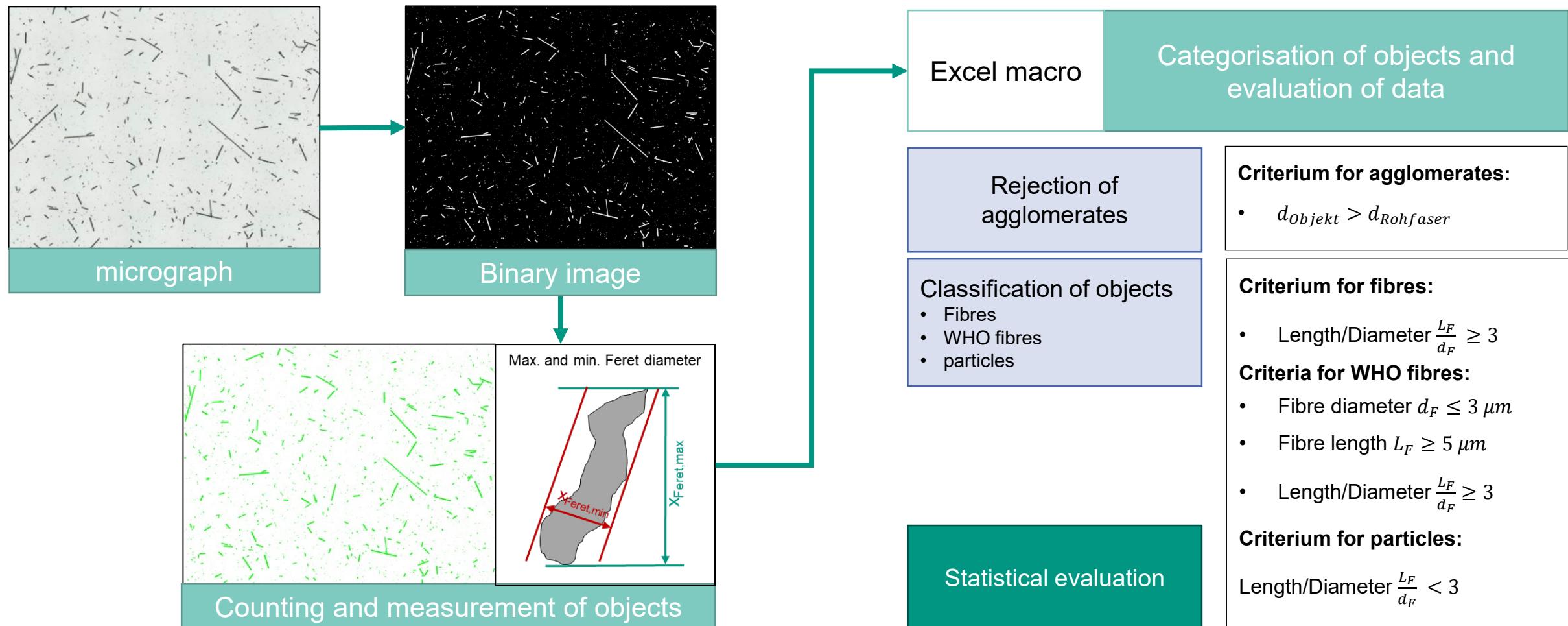


LM	Low Modulus
HT	High Tensile Strength
IM	Intermediate Modulus
HM	High Modulus
UHM	Ultra High Modulus

Classification based on the Japanese Association of CF Manufacturers

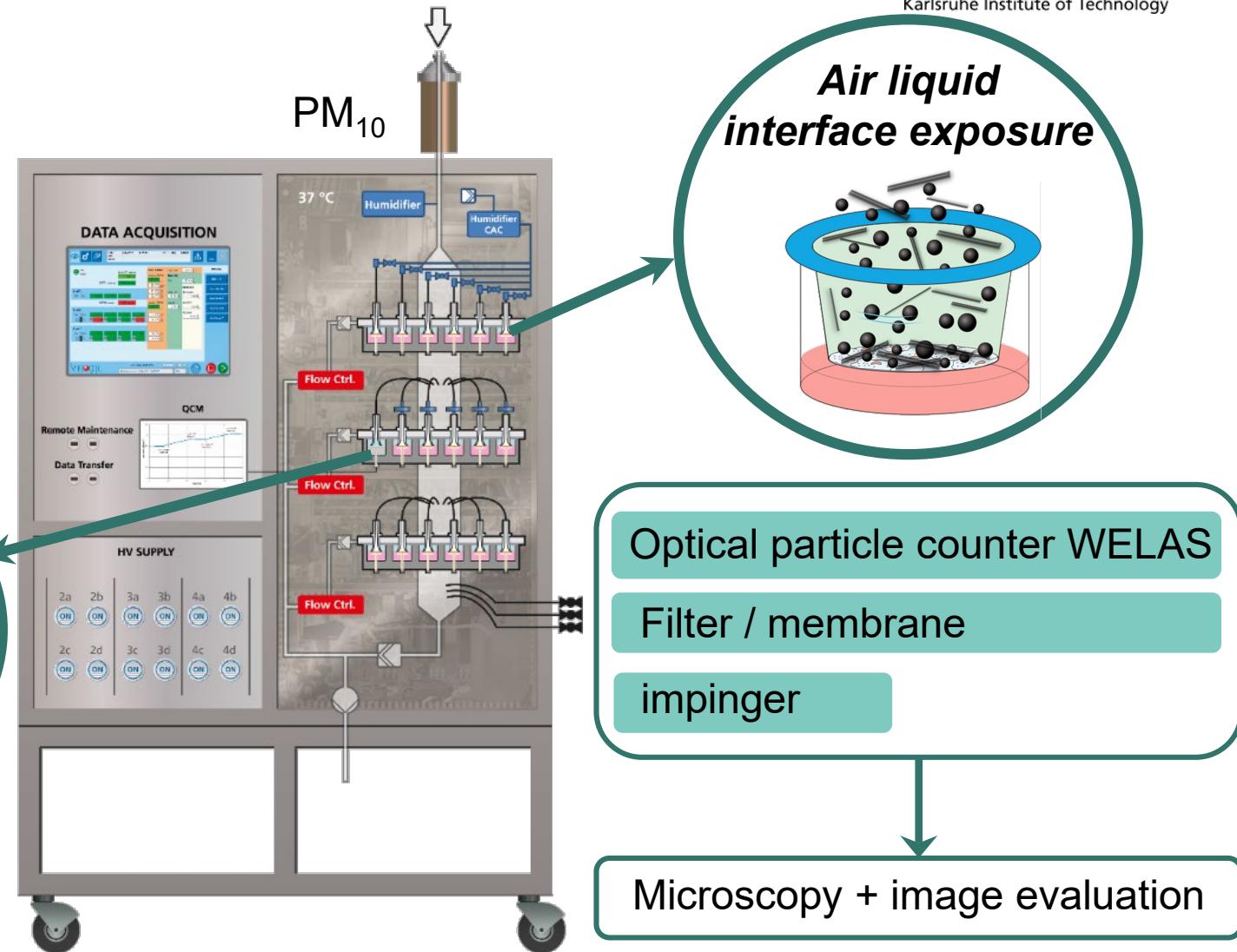
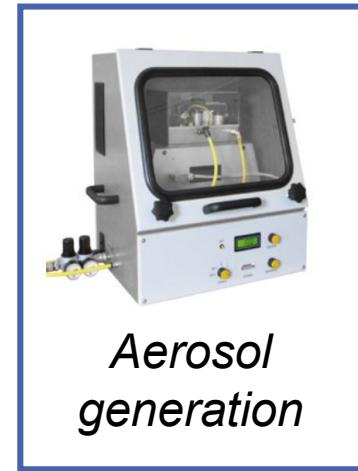
Characterisation of CF and CF fragments

Image analysis of micrographs

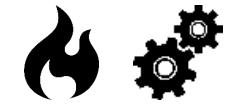
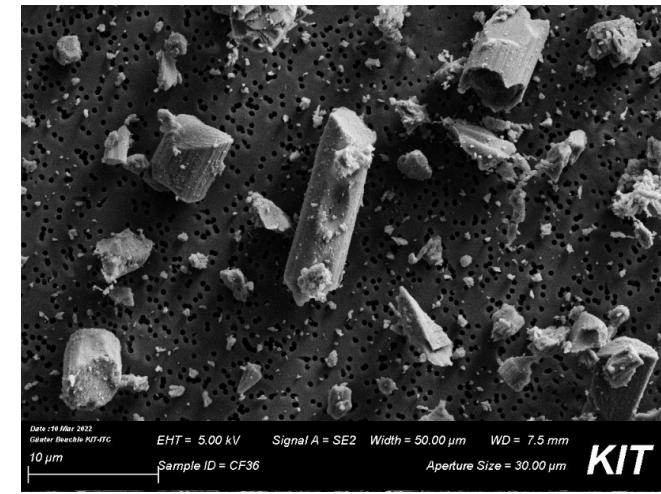
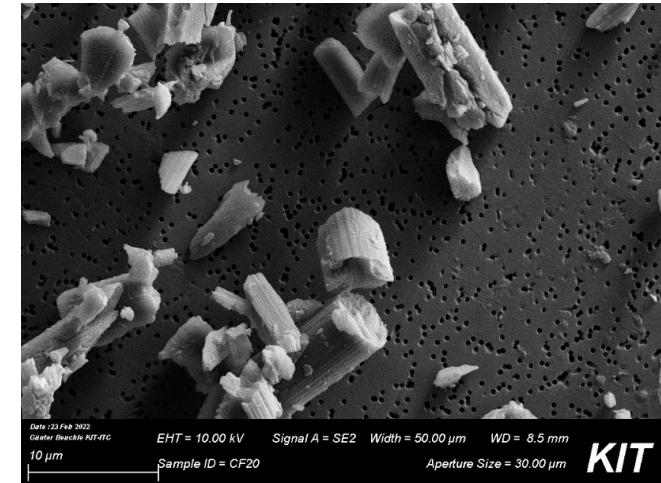
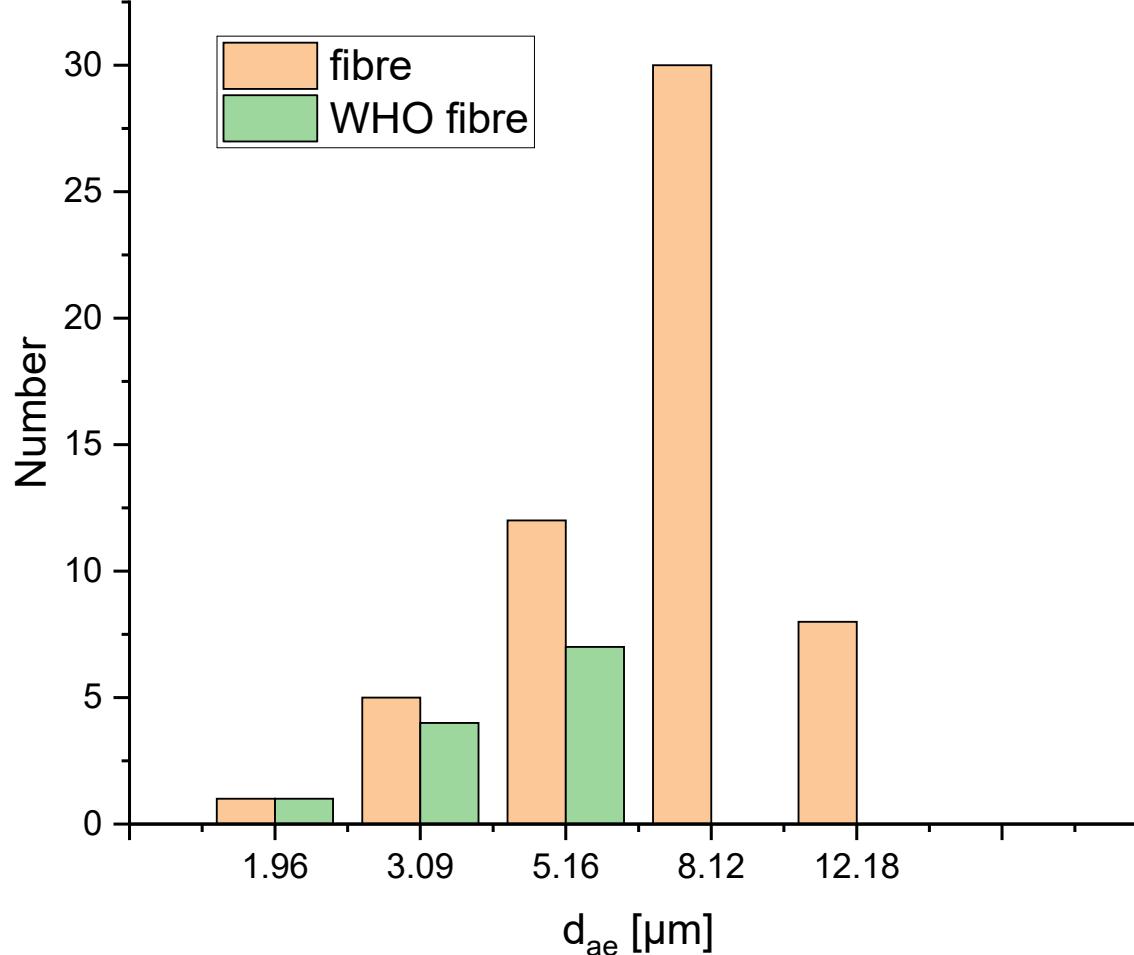


For detailed information please visit Poster F.5

CF aerosols for toxicological testing



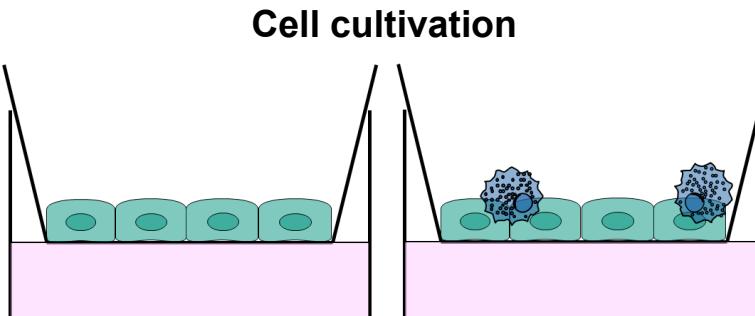
CF deposited in the exposure system



Exposure of pulmonary cell culture models to pre-treated carbon fibres (CF)



PAN based CF pre treatment

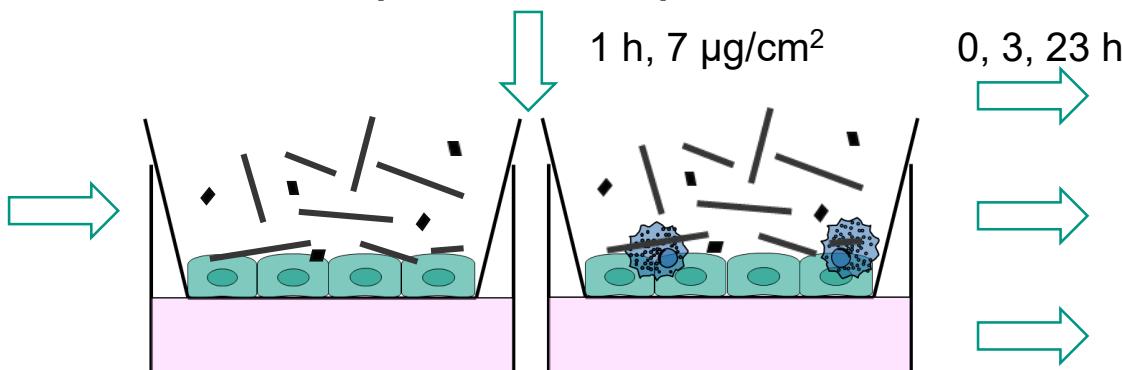


BEAS-2B bronchial epithelial cells

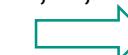
dTHP-1 differentiated macrophage-like cells



Air liquid interface exposure



0, 3, 23 h



Cytotoxicity



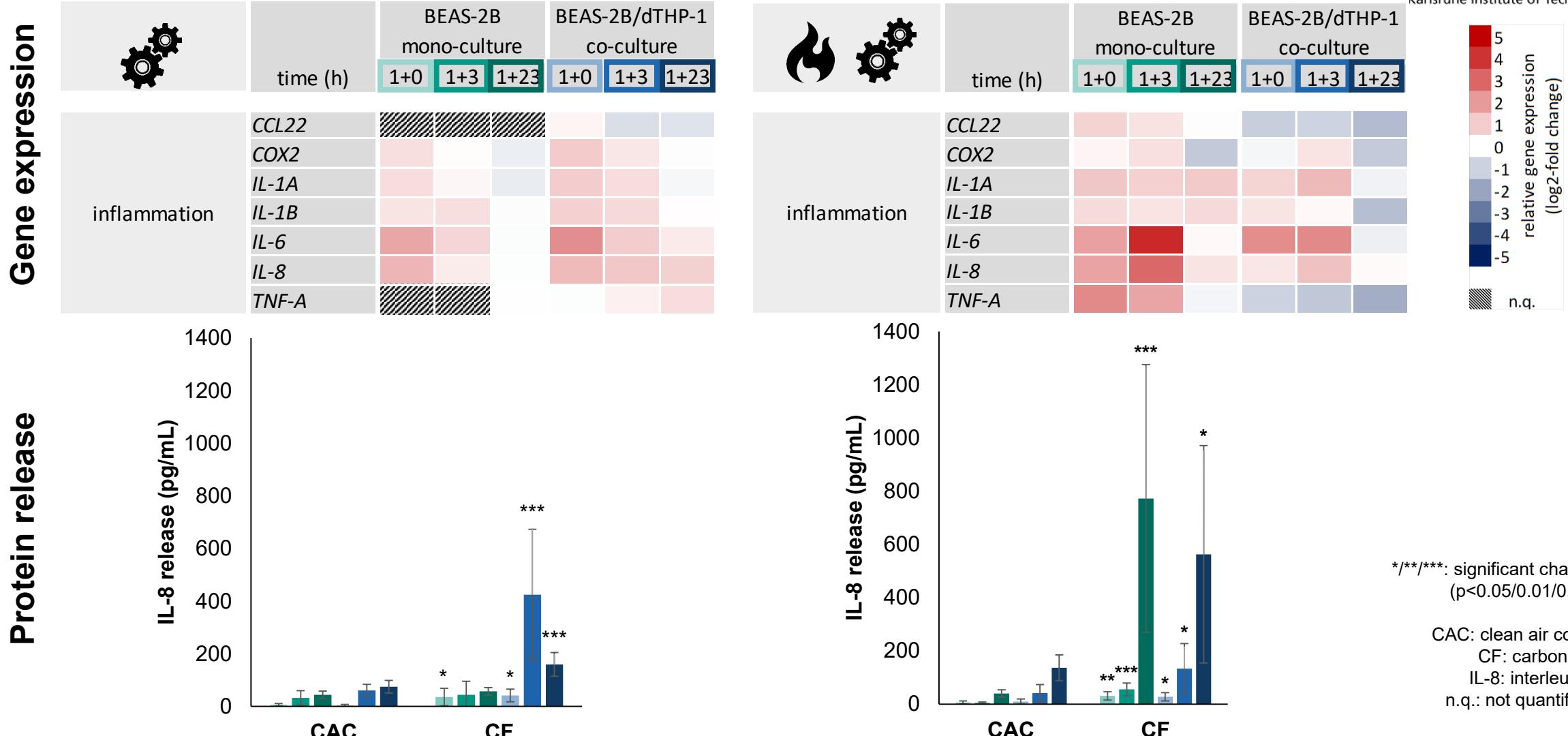
HT RT-qPCR



IL-8 ELISA

HT RT-qPCR: high-throughput RT-qPCR
IL-8: interleukin 8

CF cause inflammation in dependence pre-treatment



Material flow analysis

- Choose of 7 representative carbon fibres
- Representative of each fibre types: HT, IM, HM, and UHM fibres
- Common types with the corresponding project CarboBreak

Investigations of the thermal and mechanical behaviour of CF/CFRP

- Degradation of CF under thermal stress depends on atmosphere and fibre type
- CF break and splinter depending on mechanical energy input and fibre type

Poster F.5

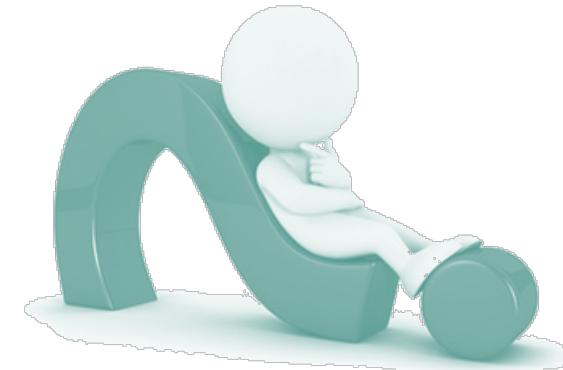
Supply and characterisation of inhalable CF

- Mechanical fibre processing can cause WHO fibre fragments
- Thermal-mechanical fibre treatment can cause WHO fibre fractions
- WHO fibre-containing aerosols can be reproducibly generated and deposited with defined doses on human lung cell lines

Toxicological testing of CF

- Mechanically treated HM fibres induce pro-inflammatory and cellular stress responses
- Thermal-mechanical treatment of HM fibres appears to enhance the effects
- Macrophages enhance or reduce response depending on fibre treatment

Formulation of recommendations for action



Questions ?



Leibniz-Institut für
Verbundwerkstoffe

