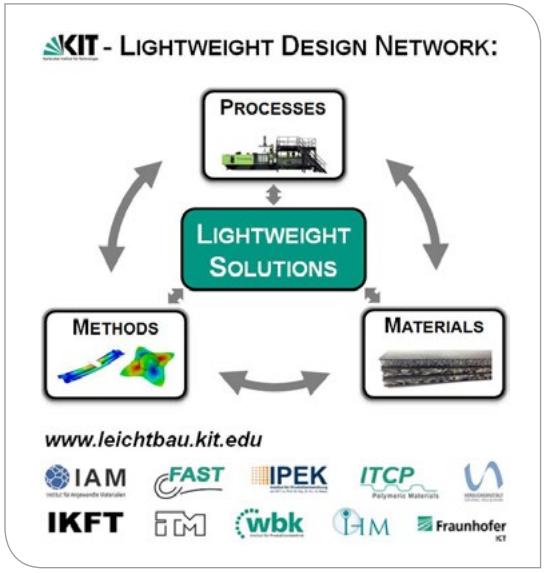
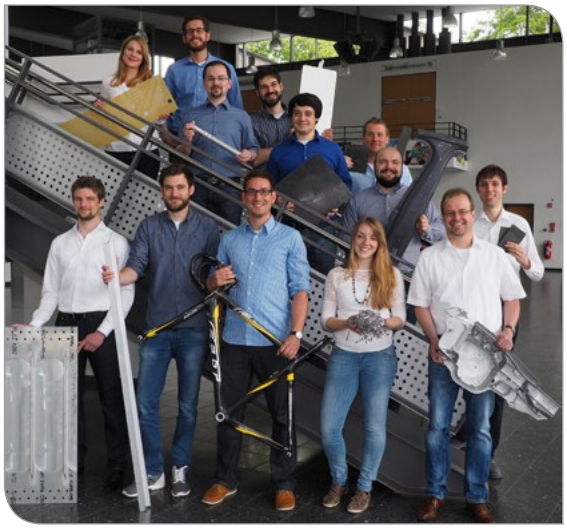
KIT Lightweight Design Network

IAM-WK is part of the KIT Lightweight Design Network, consisting of several research institutes, bundling profound expertise and thus guaranteeing **optimised lightweight solutions**.

All key areas of lightweight design, **processes, methods and materials** are integrated through co-operation of highly specialised partners and subject to continuous improvement.

Novel **processes** are created, increasing the degree of automation and enabling large-scale manufacturing of lightweight structures.
Research includes **methods** for a continuous CAE chain that virtually combines design, production and structural validation.
Within the network, IAM-WK is responsible for the characterisation of composite structures and helps developing innovative hybrid **materials**.





Contact
Karlsruhe Institute of Technology (KIT)
Institute for Applied Materials (IAM-WK)
Hybrid and Lightweight Materials Section

Prof. (apl.) Dr.-Ing.
Kay André Weidenmann

Telefon: +49 721 608 44165
Fax: +49 721 608 48044
E-Mail: kay.weidenmann@kit.edu
www.iam.kit.edu

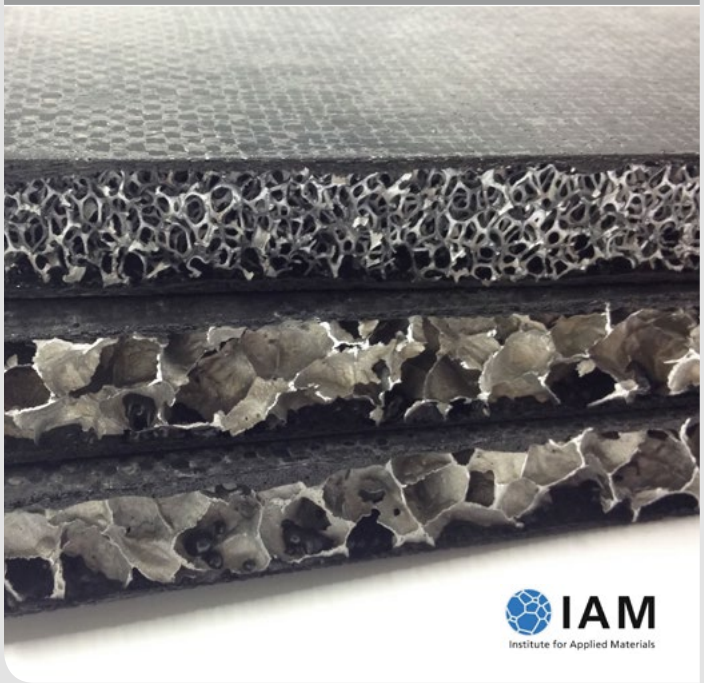
Edited by
Karlsruhe Institute of Technology (KIT)
Kaiserstraße 12
76131 Karlsruhe, Germany
www.kit.edu

Karlsruhe Institute of Technology

Hybrid and Lightweight Materials

Processing – Microstructure – Properties

INSTITUTE FOR APPLIED MATERIALS



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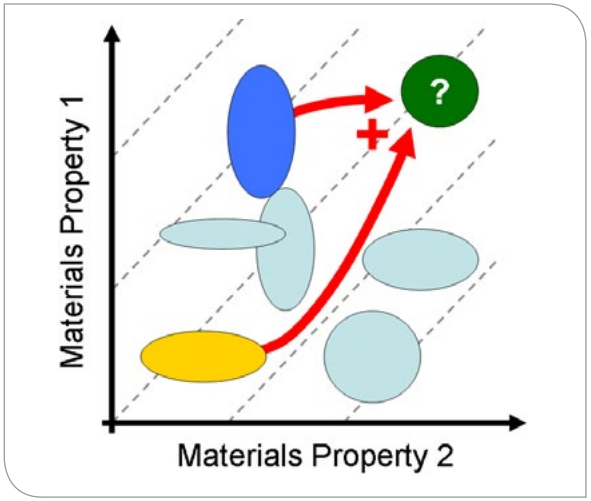
Greater than the sum of its parts

Lightweight design increases performance as well as efficiency of vehicles and gains importance in modern development processes.

Key elements are **novel material concepts**, reducing the mass of structural components, while simultaneously improving their mechanical behaviour.

Hybrid materials, i.e. composites or compounds, made or joint from several materials, combine the benefits of different material classes and have characteristics that are better than the sum of the individual components.

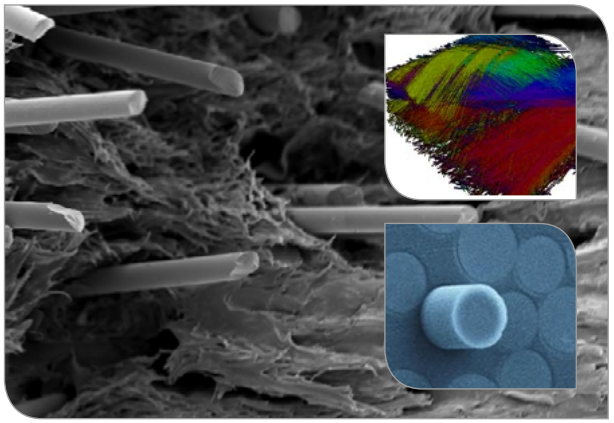
Polymers and light metals, such as aluminium and magnesium posess **high lightweight potential**, due to their low density, but often have an insufficient strength or stiffness. **Reinforcements** in the form of fibers and particles overcome these limitations and create materials with outstanding new properties.



Composing composites

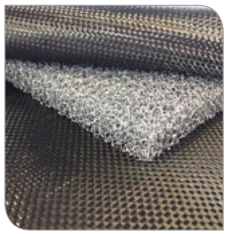
The composite`s components, their volume contents, their constitution as well as the processing have significant impact on the microstructure, the interface evolution and as a result, the **properties of composite materials**.

Extensive knowledge of the **composite`s structure** is a prerequisite to understand the materials behaviour. The derivation of correlations between **processing, microstructure and properties** of hybrid materials is therefore a central research activity at the Hybrid and Lightweight Materials Section of IAM-WK.



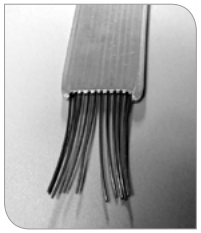
Mechanical properties of novel composite materials are determined with the help of various characterisation methods, including dynamic and impact testing. **Microstructures** are examined by materialographic, electron microscopic and computed tomographic (CT) analysis. 3D-deformation and failure behaviour can be investigated through **in situ CT testing methods**. Once the correlations are clear, parameters can be modified specifically and **composites and compounds tailored** to the needs.

Research topics



Hybrid Sandwich Composites with various core structures and face sheets of reinforced plastic, joined through polyurethane spray infiltration process, thermal joining or thermoplastic foam injection moulding.

Hybrid Laminates Composites consisting of continuous and discontinuous fiber reinforced polymers and sheets of lightweight metal.



Unidirectional Composite Profiles made in multi-stage extrusion processes, with not only structural reinforcements, but also functionally integrated components, such as insulated electrical conductors.

Metal Matrix (Interpenetrating) Composites with ceramic reinforcements, manufactured via liquid phase processes like gas pressure infiltration.

Intrinsic Hybrid Bonds, created during the initial forming process step that join fiber reinforced plastics with metal components, such as load-transmission inserts.