INNOVATIVE FERTIGUNGSTECHNOLOGIEN FÜR EINEN SYSTEMEFFIZIENTEN LEICHTBAU

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BMBF-Technologiegespräch „Neue Materialien und Fertigungstechnologien für den Leichtbau”
08.11.2018, Stuttgart
Content

- The Multi Material Approach
- System Efficient Lightweight Technology
- Promising Technologies
- Project Case Studies
  - BMBF Smile
  - BMBF MoPaHyb
Multi-material design as most promising lightweight technology approach

- CoFRC-DiCoFRC and FRC-metal hybrids

Source: Porsche

New Opportunities & New Challenges

Further development of **methods**, **materials** and **processes** to access opportunities

Source: Adient Automotive
System Efficient Lightweight Technology

Component performance + Economics

**MMP-Approach**

**Areas of Interaction**

- Materials
- Processes
- Methods
- System Efficient Lightweight Design
- Time
- Costs
- Quality

04.12.2018

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Promising Technologies for Hybrid Lightweight Components

- Local reinforced Sheet Molding Compound - Tailored SMC
- Durometer Injection Molding
- Wet Compression Molding
- Thermoplastic Tapeplacement in Combination with Hybrid Molding
  - Co-Compression Molding
  - Co-Injection Molding
Tailored SMC – Process Sequence

**Flowable** glass fiber reinforced SMC
- form complex ribs
- integrate optional metallic inserts
- low material price

**Non-flowable** carbon fiber reinforced Prepreg
- high mechanical properties
- 50k carbon fibers to reduce material costs
Thermoplastic tape placement and co-molding
From UD-Tape to Hybrid Structures

- **Tapelaying**
  - Blank geometry optimization

- **Consolidation**
  - Pressure distribution & fiber orientation

- **Thermostamping**
  - Forming simulation (fiber re-orientation, wrinkles, …)

- **Co-Molding**
  - Mold filling & temperature field simulation, warpage prediction, structural simulation

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Thermoplastic tape placement
The efficient route to tailored blanks made of UD tapes
Project Case Studies
Thermoplastic Tapeplacement in Combination with Hybrid Molding

- BMBF SMILE – AP3 Thermoplast
- BMBF MoPaHyb
SMiLE Project – SMiLE lightweight car body for e-mobility
AP3 Thermoplast underbody demonstrator

- Rear underbody floor using local advanced tailored LFT
  - Process development for optimized insert stability and local overmolding
  - Holistic demonstrator development

Sequential UD tape forming simulation

Mold filling simulation using LFT-D

Structure and crash simulation

Dominik Dörr, KIT FAST
Martin Hohberg, KIT FAST
BASF Ultrasim

Demonstrator – Thermoplast underbody: Mold concept
Demonstrator – Thermoplast underbody: Manufacturing

SMiLE Project: Hybrid Thermoplastic Composite Floor Module
Future Hybrid Lightweighting Technologies – 2020

- Small badge sizes, part derivatization and plant investment costs for individual products may inhibit economic feasibility
  - Due to reconfigurable production plants with easy adaptation to similar products the plant efficiency can be improved
  - New business models enable economic production of hybrid components with varying lot sizes

**Vision:** Adapted value added chain for hybrid lightweight components

- Early benefit of lightweight potential
- Cost reduction of hybrid components
- Economic feasibility also for small lot sizes
- Adaptation to different variants
„MoPaHyb“
Modular production plant for hybrid high performance components

- Development of a modular and reconfigurable production plant using the example of hybrid thermoplastic components
- Development of a plant architecture with production modules and a base control unit using standardized communication protocols
- Demonstration and plant validation via two individual products

![Diagram of production modules](image)
„MoPaHyb“
Modular production plant for hybrid high performance components

Modular plant architecture
- Plug & work functionality
- Fast and efficient reconfiguration (incl. plant control)
- Integrated engineering

Innovative lightweight technologies
- Intelligent tape placement
- Metal-FRP interface optimization
- Modular LFT injection molding aggregate
- Functional handling systems

Plant demonstration
Business model development as exemplary commercialization strategy

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Demonstration plant and process
Configuration 1

Hybrid CFRP seat backrest
(source: Adient)
Demonstration plant and process

Configuration 2

Hybrid D-LFT underbody component
(source: BMBF MaiQFast)
Plant installation for configuration 1 completed, start of reconfiguration
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*Dieffenbacher Hydraulic Press*

*Siemens base control unit*

*Dieffenbacher Fiberforge*

*Arburg FDC Aggregate*

*Siemens base control unit*

*Kuka robotic and gripper toolbox*

*wbk IR – Heating module for tailored blanks*

*A. Raymond supply of metallic load introduction inserts*

*Supply of metallic reinforcement structures from Trumpf*
Fully automated production in configuration 1
Thanks for your kind attention - Any Questions?

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