FASERINSTITUT FIBRE BREMEN

SOfIA

Structural Organic Sheet Components for Integration in Automobiles

PROJECTS

Motivation

Fibre reinforced lightweight materials in structural automotive components are limited to niche sectors like luxury and sports applications due to high costs. Mixed material designs offer weight-savings which result in enhanced performances and less fuel consumptions. Reduced manufacturing costs for fibre reinforced car components and the design of hybrid material car concepts enable to go downmarket with new products. A great challenge is to enhance quick and reliable joining technologies for structural mixed material products, especialliy for high performances in the aviation or in the automotive sector.

Approach

The fabrication of automobiles for the mass market is significantly dominated by automated manufacturing technologies where single process steps infrequently take longer than one minute. The joining of different materials and the realisation of hybridised car structures are key elements to mature new multi material designs in the automotive mass market. Actual joining technologies for different materials consider adhesive bonding and mechanical fasteners, which often carry time-consuming curing times and cost-intensive production expenditures.

Figure 1: Metallic Car-Body Part

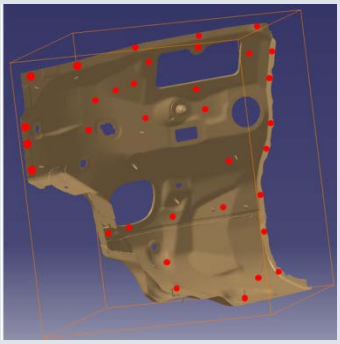

Figure 2: 3D-Model with welding spots

The research project SOfIA aims for the development of hybridised organic sheet metal elements, which can be welded to metallic car body structures by using spot-welding processes in serial productions.

With respect to short cycle times, a thermoplastic matrix is used to press a composite car part in form, including metallic inserts and organic sheet patches fixed to the part's structure in the hot stamping process.

Production rates of one part per minute offer to be suitable for automobile mass productions. The so prepared organic sheet body part contains areas to be welded on metallic structures. The inserts used to be welded on the metallic car body are surface-treated to enhance insulating and coupling properties. Taking into account the process conditions, the material properties as well as the thermal and mechanical demands, a demonstrating car body part is produced in a modified thermoforming process. Exact patch positioning and full process integrity of the composite part are fundamental elements to mature the new technology to be useful for welding processes in series production.

The mechanical properties are achieved by several types of insert-geometries respecting different load cases (e.g. torsion, pull-out, tension). The adhesion between suitable metal-plastic material combinations is analysed to obtain repeatable results and to reach for a maximum of joining strength. Pull-out properties are tested on coupon sized components, as displayed in Figure 4.

Figure 3: Different insert geometries

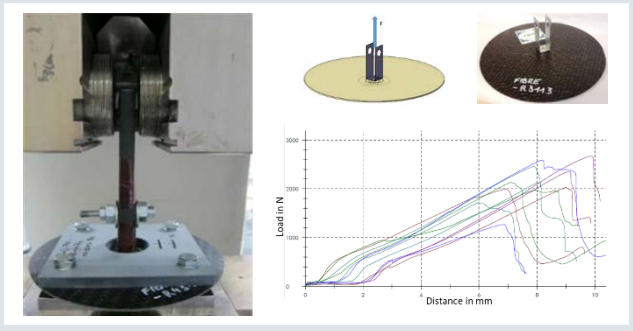

Figure 4: Pull-out tests with insert coupons

Possible Applications

The insert-modified semi-finished products can be deployed in series spot-welding processes and can be adapted to other material combinations (e.g. GF/PA6/STEEL, GF/PEI/AL, CF/PEEK/Ti) for structural mixed hybrid material designs in applications for:

- Automotive
- Transport & Engineering
- Aviation
- Energy, Oil & Gas

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- Faserinstitut Bremen e.V. - FIBRE

Faserinstitut Bremen e.V.

The Faserinstitut Bremen e.V. (FIBRE) is a scientific institute situated on the campus of the University of Bremen with more than 60 years experience in the fields of characterisation, development and processing of technical fibres and fibre based composites. The development of new processes, increased material efficiency, reduction of cycle times and testing of new lightweight construction concepts are part of the research activities in the department of Composite Design and Manufacturing Technologies.

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