TECHNICAL UNIVERSITY OF KOŠICE
Faculty of Mechanical Engineering

HORIZON-CL4-2022-RESILIENCE-01-12: Functional multi-material components and structures (RIA)

Ideas for the project:
Optimised lightweight designs often require the use of multi-materials, often with different physical properties, such as polymers composites and metals. The manufacturing of multimaterial structures is thus a challenging task and many industries are today addressing specific critical challenges that come with mixing of materials. It is of great importance that multimaterial design is analysed from a holistic and multidisciplinary perspective where all aspects from design to manufacturing, use and recycling are included in the process. This will help industry make the change from traditional design based on one material to multi-material design of lightweight structures.

Our ideas for the project:
Concepts of materials used for different multi-material constructions differ, with the aim of reducing weight. Construction concepts are based on the use of different types of materials such as ferrous and non-ferrous metals, polymer composites. Recently, however, there has been a significant increase in the use of composite materials, mainly based on carbon fibers. The question thus remains not only how to produce individual parts of the multi-material structure, but also how to join them into a functional unit.

Previous solutions: Complex material analysis of experimentally prepared samples from various materials, especially on the basis of steel sheets and aluminium alloys sheets. Optimization of joining processes by means of numerical simulation, prediction of local deformation. Increasing the life of tools for mechanical joining by applying PVD coatings. Use of a combination of joining methods such as clinching and clinch-riveting with adhesive bonding when joining hybrid multi-material concepts.

Experience and infrastructure offered:

1. Up to date infrastructure for testing the mechanical and technological properties, macro and microstructural observations, chemical composition
2. Collection and evaluation of joining data

Projects solved, related to the issue:

1. Increasing the efficiency of forming and joining parts of hybrid car bodies (The Slovak Research and Development Agency), see Kaščák Ľ., Spišák, E.: Clinching - a progressive method of joining sheets, 2020, 150 p. ISBN 978-80-553-3074-7
2. Several national projects focused on forming and joining the car body sheets – various grades of steel sheets, aluminium alloy sheets. Joining materials by spot welding, mechanical joining – clinching, clinch-riveting, self-piercing riveting, friction stir welding). Joining the combination of steel sheets and aluminium alloy sheets by mechanical joining methods and combination of mechanical joining and adhesive bonding. See Fatigue Life Assessment of Refill Friction Stir Spot Welded Alclad 7075-T6 Aluminium Alloy Joints (https://www.mdpi.com/2075-4701/10/5/633), Wear of Shaped Surfaces of PVD Coated Dies for Clinching (https://www.mdpi.com/2075-4701/7/11/515), The experimental analysis of forming and strength of Clinch Riveting sheet metal joint made of different materials (https://journals.sagepub.com/doi/full/10.1155/2013/848973), Mechanical joining of aluminium alloy sheets (https://www.mmscience.eu/journal/issues/december-2020/articles/mechanical-joining-of-aluminium-alloy-sheets).

Partners in previous research projects:
Lublin University of Technology, Rzeszów University of Technology, Brno University of Technology, Czech Technical University in Prague, Technical University of Liberec.

Contacts to industrial partners:
VW Slovakia, Embraco Slovakia s.r.o., U.S. Steel Košice, s.r.o., SEZ Krompachy a.s., SAD Levoča, KEREX, s.r.o., Oerlikon, Michatek, Energyco

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