

## Introduction

Refill friction stir spot welding (RFFSSW) was developed and patented at the Helmholtz-Zentrum Geesthacht and has been successfully investigated for both similar and dissimilar welds of metallic alloys. Furthermore, a process variant has been developed – Friction Spot Joining (FSpJ) - for hybrid metal-polymer and metal-composite joints. Preliminary studies showed the potential of applying RFFSSW to polymer-polymer and composite-composite joints. With increasing interest from the aircraft and automotive industries, this friction-based technique could overcome the limitations (*i.e.* surface preparation, thickness limitations, accessibility, etc.) of conventional welding technologies for advanced polymeric composites, such as laser-, resistance- or induction welding.

The scope of this work is to investigate the RFFSSW process for aircraft composites, like CF-PEEK, CF-PEAK, CF-PEKK in various thicknesses with focus on joint formation, microstructural characterization and process-related changes in physical-chemical properties as well as basic rheological aspects. Process optimization through design of experiments (surface design, ANN, etc.) for maximum mechanical performance (both quasi-static and dynamic) is a further aim the study.

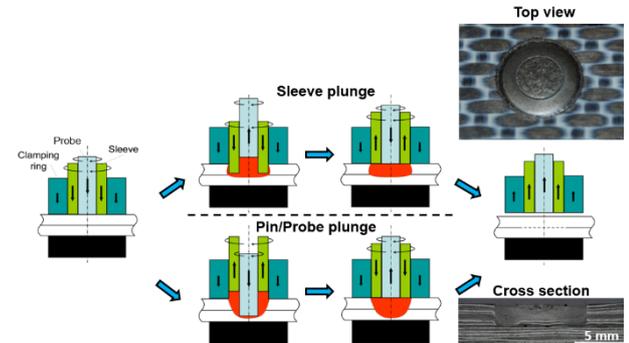
The place of employment would be the Helmholtz-Zentrum Geesthacht.

## Tasks

- Literature research (tribology of polymers, fundamentals of polymer rheology, welding and joining of composites)
- Performing welding experiments and trials, respectively process optimization via design of experiments
- Weld characterization: microstructural analysis, temperature development, assessment of physical-chemical properties, determination of mechanical properties and fracture behaviour
- Presentation of the results and documentation of the experimental work (in English or in German).

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Schematic of the RFFSSW-process. The two process variants – sleeve and pin/probe plunge, respectively – are presented, alongside top and cross sectional view of a CF composite joint



Hybrid metal-composite aircraft fuselage demonstrator joined entirely with friction-based processes. Build at HZG / Solid State Joining (WMP)