



## ADVANCING THERMOPLASTIC COMPOSITE TECHNOLOGIES

### FUSION BONDING APPROACH FOR JOINING THERMOPLASTIC TO THERMOSET COMPOSITES

#### ThermoPlastic Composites Research Center (TPRC)

The ThermoPlastic Composites Research Center ([www.tprc.nl](http://www.tprc.nl)) is an open research center for fiber-reinforced thermoplastic composites. TPRC performs research in cooperation with national and international partners, such as Fokker, Toray and Boeing, on the processing and performance of thermoplastic composites.

#### Project background

The known benefits of thermoplastic composites (TPC) – rapid processing, inherent toughness, and environmental stability – can be exploited to a greater extent when they can be applied in multi-material designs. Of specific interest is the mixed use of TPC with the more widely applied thermoset composites (TSC), which have become the first material of choice in lightweight aerospace structures. As both types of material families possess different properties, joining them in a robust way to serve in semi-structural aerial applications, is a big challenge and of high interest.

Common joining approaches to connect dissimilar materials are based on intermediators, such as mechanical fasteners. These frequently used methods for joining materials have different advantages, but they all share a significant drawback - a non-continuous interface between the joined parts, which can compromise the joint's integrity.

A composite-driven joining approach can create a stable and continuous interphase via chemical bonding and/or interdiffusion for a durable and structural joint. The novel "hybrid adhesive" approach involves a coupling film as an intermediator with chemical affinity to both TPC and TSC adherends.

Fusion bonding techniques, including press forming and induction welding, that are frequently employed to shape and join TPC components, can be optimized to join TPC to TSC via the aforementioned coupling layer. One possible challenge of using such a technique is the risk of thermoset (TS) resin degradation caused by the high temperatures required to melt the thermoplastic (TP) matrix.



## ADVANCING THERMOPLASTIC COMPOSITE TECHNOLOGIES

### Project description

The objective is to optimize a suitable fusion bonding process to bond TPC to TSC using a coupling film while taking into account the process parameters and their effect on material behavior. The bond quality will be assessed using microscopy, thermo-chemical, thermo-gravimetric, and mechanical analyses. Commercial materials will be used for this project which already showed promising results in a 'proof of concept' phase.

### Tasks description

- Literature overview to include:
  - o Studies on TPC-TSC joining approach using coupling layer
  - o Potential fusion bonding methods
  - o Suitable characterization tools
- Creation of test samples through a selected technique while optimizing the manufacturing process to achieve desired joint quality
- Characterization of material behavior (TP crystallization, TS degradation, interfacial strength), such as DSC, TGA, etc.
- Mechanical testing using suitable method(s)
- Data analysis and results reporting

### Requirements from student

- Master student of Chemical/Material/Mechanical Engineering
- Sufficient spoken and written English
- Prior experience with experimental lab work; process optimization, material characterization and mechanical testing - advantage
- Prior knowledge in the material processing and characterization, advantage for composite materials
- Experience with Office-based software: Excel, PowerPoint
- Prior usage of programming languages; Matlab, Python, etc.
- Duration: MSc thesis (8 months minimum)

### Further information

Please contact Liran Katz ([Liran\\_katz@tprc.nl](mailto:Liran_katz@tprc.nl) or 0644918237) for additional information.