

Executive Summary Deliverable 3.1

“Recipe book” report with metal-polymer process parameters

Goals of the Deliverable (public)

This deliverable aims to provide a "recipe book" style procedure for metal-to-polymer bonding strategies, specifically for overwrapping wire direct energy deposited aluminum with carbon fibre-reinforced composites using thermoplastic polymer matrices.

This document outlines strategies and principles for utilizing the laser-assisted Automated Tape Laying (ATL) process to achieve direct bonding to metals while addressing their different material properties. The requirements for creating bonds between dissimilar materials are considered. For thermoplastic matrices to adhere to metal, they must be in a molten state to form a bond. However, the temperatures required to melt the thermoplastic polymer without quenching it on the metal surface often exceed the modification temperature of the aluminum alloy's microstructure.

Therefore, this document demonstrates processing pathways for bonding carbon fibre-reinforced thermoplastic materials such as PE, PP, PC, PET, PA6, and PA12 to an aluminum substrate. The baseline involves applying film, powder, or liquid-dissolved co-polymers that maintain temperatures below the grain modification threshold, ensuring compatibility with the ATL process and meeting the temperature stability requirements for automotive applications.

The results of the compression shear test reveal bonding strengths of 20 MPa and 18 MPa for PA6 and PA12, respectively. Bonding strengths of 16 MPa were obtained using PC, 15 MPa using PP, and 12 MPa using PET. No bonding was achieved using PE.