Hybrid joining process of CFRP and metallic parts for the ultra-lightweight structure

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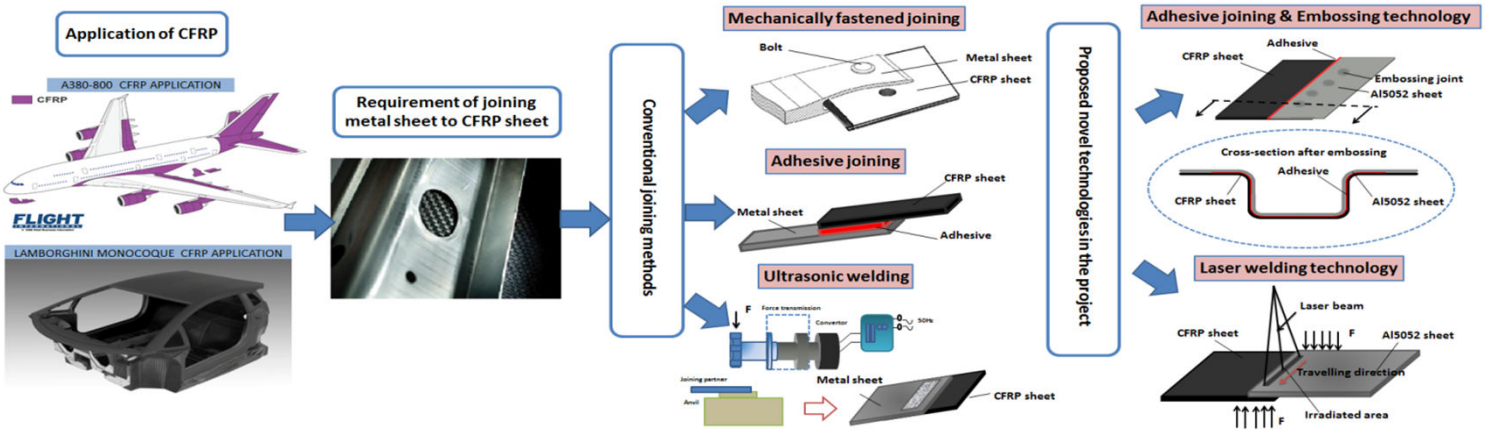
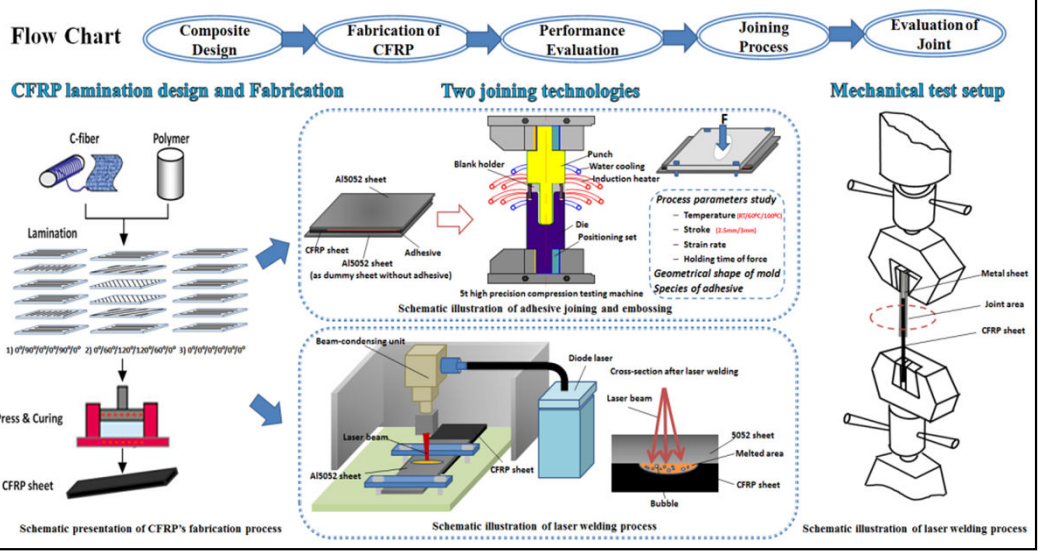
Introduction and Background

Currently, the applications of CFRP sandwich sheets have been broadened in the area of aircraft and automobile because of its environmental, cost-effective and high-performance features. Nevertheless, realizing the joining CFRP sheet to metal sheet remains an essential challenge at present, due to the low shear and bearing capabilities, poor plasticity, high notch sensitivity, inherent complex fracture mechanics of CFRP materials, etc. The large-scale application of the conventional CFRP-metal sandwich sheets joining technologies(e.g. mechanically fastened joining, adhesive joining and ultrasonic welding) is restricted by the large amount of cost and energy consumptions and the low efficiency. The present work concentrates on two fields, of which the first one is to achieve the joining of CFRP and SUS304 sheet by plastic technology----embossing, which has never been concerned in the previous publication; the second one is to realize the laser welding of CFRP-metal sandwich sheets with low thermal strain and deflection.

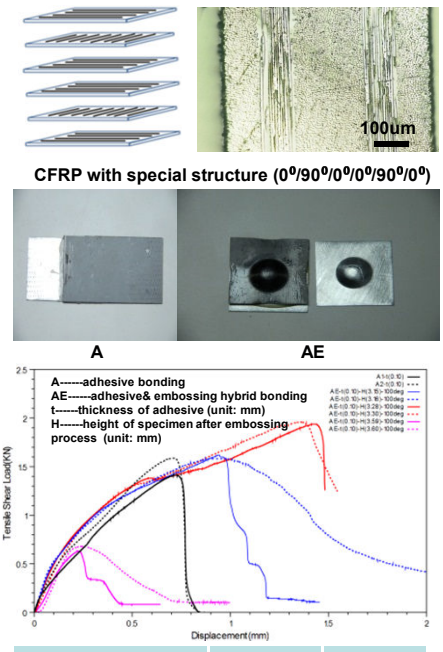
The investigations of all process sequences involve adhesive bonding & embossing and subsequent laser welding. Optical microscope, scanning electron microscope and mechanical test system enable the analysis of the effect of different orientation of lamination, geometric factors and the process parameters of the two joining technologies on the joining quality.



Experimental and Test Setup



Experimental Results



Joining Condition	Max TS Load(KN)	Max Dis (mm)
A	1.51	0.72
AE(depth:2.05mm)	1.62	0.94
AE(depth:2.20mm)	1.98	1.44
AE(depth:2.50mm)	0.68	0.22

Fracture mechanism of the joint