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Joining of carbon fibre reinforced polymer to Al-Si alloy for space applications

Valentina Casalegno, Milena Salvo, Stefano Rizzo, Luca Goglio, Olivier Damiano, Monica Ferraris



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Valentina Casalegno^a, Milena Salvo^a, Stefano Rizzo^a, Luca Goglio^b, Olivier Damiano^c, Monica Ferraris^a

^a *Department of Applied Science and Technology (DISAT), Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy.*

^b *Department of Mechanical and Aerospace Engineering (DIMEAS), Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy.*

^c *THALES ALENIA SPACE, 5 Allée des gabians, BP99, 06156 Cannes La Bocca Cedex, France*

Corresponding author: Milena Salvo, Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy; milena.salvo@polito.it; phone: + 39 0110904706; fax: + 39 0110904624.

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Abstract

The joining of hypereutectic Al-Si alloy heat pipes to CRFP skins has been studied for radiator panel applications. Three different epoxy adhesives (two thermal conductive adhesives and one high-strength structural one) were used and mechanically characterised before and after thermal cycling. Two adhesives gave the most promising results, in terms of mechanical strength (apparent shear ~ 25 MPa for 100 μm thick lap joints). Thermal cycling (10 cycles between -30°C and $+90^\circ\text{C}$) did not significantly affect the mechanical properties of the joints or the failure propagation mode. The use of the thermal conductive adhesive could also guarantee good thermal conductivity of the designed panel.

1. Introduction

Reliable heat dissipation systems in space applications, where miniaturised electronic devices are becoming more complex and powerful, are a growing challenge. New, advanced packaging solutions for thermal management systems include honeycomb sandwich panels with embedded heat pipes [1, 2]. In ref. 2, aluminium heat pipes were embedded in a sandwich panel and thermally coupled to graphite face sheets using a high thermal conductivity gasket material. In order to increase the mechanical stability, Carbon Fibre Reinforced Polymer (CFRP) composite face sheets can be used in heat pipe radiator panels [3]. Moreover, the coefficient of thermal expansion (CTE) mismatch between aluminium and CFRP could lead to internal stresses under operating conditions (i.e. an operating temperature range of

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