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An investigation of hole quality during drilling of carbon fibre reinforced plastic and titanium (Ti6Al4V) using tungsten carbide drills

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Abstract
Drilling through Carbon Fibre Reinforced Plastic (CFRP) and Titanium alloy (Ti6Al4V) in a stack is crucial for mechanical assembly of aircraft and automotive parts. This paper presents an investigation of drilled CFRP/Ti stacks hole quality in comparison to when the materials were drilled separately and individually (CFRP-only and Ti-only). The drilling trials were conducted through CFRP/Ti stacks, CFRP-only and Ti-only using carbide drills (6.1 mm diameter) at a cutting speed of 50 m/min and a feed rate of 0.05 mm/rev. The quality of the drilled holes was evaluated with respect to the hole diameters, delamination and pull-out of CFRP as well as Ti burr. It was found that drilling CFRP/Ti stacks resulted in severe Ti adhesion on the cutting edges, which caused oversized drilled holes. CFRP delamination and pull-out was found to increase by 22%-62% and 170%-530% during drilling of CFRP/Ti stacks in comparison to those produced by drilling of CFRP-only. The high damage to CFRP when drilling CFRP/Ti stacks compared to drilling CFRP-only was mainly due to sharp Ti chips, which evacuated through the CFRP plate. Furthermore, it was found that Ti burr which formed at the hole exit increased as tool wear increased. This study suggested that the hole quality and tool life when drilling CFRP/Ti stacks can be improved by improving the evacuation of Ti chip and by reducing the adhesion of Ti on the cutting edges.

Author Keywords
Burr; CFRP; Delamination; Drilling; Hole diameter; Machining; Titanium; Tool wear

Index Keywords
Adhesion, Aluminum alloys, Carbide cutting tools, Carbon fibers, Drills, Infill drilling, Ternary alloys, Titanium alloys, Tungsten carbide, Wear of materials; Burr, Carbon-fibre reinforced plastics, Cutting edges, Drilled holes, Hole diameter, Hole quality, Plastic alloys, Pull-out, Titania, Tool wear; Carbon fiber reinforced plastics

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