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Experimental study on drilling mechanisms and strategies of hybrid CFRP/Ti stacks

Jinyang Xu^{1, 2*}, Mohamed El Mansori¹

¹MSMP – EA 7350 Laboratoire, Arts et Métiers ParisTech, Rue Saint Dominique BP508, Châlons-en-Champagne 51006, France

²School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai 200240, PR China

*E-mail address: jinyang.xu@ensam.eu

Abstract: Mechanical drilling is a frequently-used operation for high-quality finishing of hybrid CFRP/Ti stacks prior to the final fastening assembly. Owing to their inhomogeneous behaviors and poor machinability, drilling CFRP/Ti stacks in one-shot time has brought great challenges to the modern manufacturing community. Compared to previous studies on drilling CFRP/Ti, this paper aims to highlight the following aspects: (i) the feature of tool-work interaction and machinability classification dominating the bi-material drilling; (ii) the influences of different cutting sequences ($\begin{smallmatrix} \text{CFRP} \rightarrow \text{Ti} \\ \text{Ti} \rightarrow \text{CFRP} \end{smallmatrix}$) on CFRP/Ti drilling responses; and (iii) the effects of different tool geometries/materials on CFRP/Ti drilling performance. Experimental results show that the drill geometrical features, which ensure the cutting contacts of the stack combination, have a more significant effect on CFRP/Ti drilling output than tool material composition. The Ti \rightarrow CFRP drilling strategy promotes higher quality of machined hole surface (e.g., consistent hole diameter and good surface finish) with lower Ti burr formation, while the CFRP \rightarrow Ti drilling strategy reduces however the induced delamination extent. The experiments discussed in this paper allow besides several recommendations for the cutting sequence selection when drilling hybrid CFRP/Ti stacks.

Keywords: Hybrid CFRP/Ti stack; Drilling; Cutting-sequence strategy; Drill geometrical feature; Hole quality; Tool performance.

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