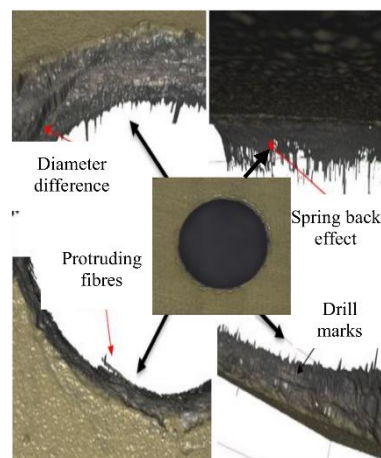


Article type: (Technical Article)

Graphical Abstract

In this study, single shot drilling is performed on the stacked-up panel which consists of carbon fibre reinforced polymer panel and aluminium alloy panel. The hole integrity performance is then analyzed experimentally based on stack up diameter error, hole circularity error and hole surface roughness and the results are verified with the help of process capability six pack statistical analysis.



Title: A Comparative Study of Hole Integrity Performance in Composite-Metal Stacks Using Coated and Uncoated Tungsten Carbide Drill Bits

Titel: Eine vergleichende Studie zur Lochintegritätsleistung in Verbundmetallstape In unter Verwendung von beschichteten und unbeschichteten Wolframkarbid-Bohrern

Authors: Jebaratnam Joy Mathavan ^{1,2}, Muhammad Hafiz bin Hassan ^{1,3*}, Abdus Samad Bin Mahmud¹

¹Universiti Sains Malaysia, Engineering Campus, School of Mechanical Engineering Nibong Tebal, 14300, PULAU PINANG, MALAYSIA

²University of Jaffna, Faculty of Technology, Department of Engineering Technology, Kilinochchi premises, Ariviyal nagar, 44000, KILINCHCHI, SRI LANKA

³Advanced Machining Lab, Gandtrack Asia Sdn Bhd, 75350, Ayer Keroh, MELAKA, MALAYSIA

*Corresponding author: E-mail: ((mhafizhassan@usm.my))

Content:

1 Introduction

2 Methodology

2.1 Materials

2.2 Drilling process

2.3 Hole integrity measurement

2.3.1 Stack up diameter error

2.3.2 Hole circularity

2.3.3 Hole surface roughness

2.4 Process capability six pack analysis

3 Results and discussion

3.1 Stack up diameter error

3.2 Hole circularity

3.3 Hole surface roughness

4 Conclusions

5 References

Abstract: This study aims to develop tetrahedral amorphous carbon nanocomposite layer coated tungsten carbide drill bits for single shot drilling of composite metal stack. Different coatings were tested for hole integrity performance compared to an uncoated tool and the results were validated using process capability six-pack analysis. The drilling process employed a 4.85 mm twist drill with a feed rate of 0.05 mm/rev and spindle speed of 2600 rev/min. The experimental results indicate that, all the coated tools produce H9 tolerance holes while uncoated tool produced H7 tolerance holes with 18 % to 35 % better results. But statistical results show that all the tools including uncoated tool require improvement to stay within the control limits. The hole circularity error obtained by all the tools were below 24 μm in both the panels and is supported by the statistical results as well. The uncoated tool exhibited 17.91 % better surface roughness in aluminium panel compared to coated tools, while coated tools produced 17.2 % to 22.3 % better surface roughness in composite panel. Statistical results suggested that, improvement is necessary when drilling aluminium panel by all the tools while dopant added coated tools produce better results in composite panel.

Keywords: Composite metal stacks, tetrahedral amorphous carbon coating, process capability six pack analysis, hole integrity performance, single shot drilling