Advances in Production Engineering & Management
Volume 14 | Number 4 | December 2019 | pp 407–420
https://doi.org/10.14743/apem2019.4.337
ISSN 1854-6250
Journal home: apem-journal.org
Original scientific paper

Femtosecond laser helical drilling of nickel-base single-crystal super-alloy: Effect of machining parameters on geometrical characteristics of micro-holes

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A B S T R A C T

Laser micro-hole processing has been widely used in industry. Many laser processing parameters can affect the processing results. The relationship between the geometrical shapes of micro-holes and the laser processing parameters has not been determined accurately. In this paper, experiments on the femtosecond laser drilling of the nickel-base single-crystal super-alloy (DD6) materials were conducted to determine the relationship between the parameters, such as the laser single-pulse energy, rotation rate, and downward focus rate, and the geometrical characteristics of the micro-holes, such as the diameter, and roundness. A group of orthogonal experiments were conducted to determine the effects of the comprehensive influencing factors on the geometrical characteristics of the micro-holes. After the experiments were conducted and analysed, the experimental results were modelled by a backpropagation neural network, and the mapping relationship between the laser parameters and the geometrical morphologies of the micro-holes was constructed. The model established by the backpropagation neural network could obtain accurate prediction results, and the predictions of the diameters of the micro-holes were better than those of the roundness.

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A R T I C L E I N F O

Keywords:
Femtosecond laser;
Micro-hole machining;
Helical drilling;
Nickel-base single-crystal super-alloy (DD6);
Orthogonal experiment;
Artificial neural networks (ANN)

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Article history:
Received 26 November 2019
Revised 10 December 2019
Accepted 11 December 2019

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