A Mathematical Model of Laser Drilling

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Abstract

Laser drilling has been widely used for producing small diameter holes in hard-to-machine materials for decades. Of particular interest is laser drilling of cooling holes in aircraft turbine blades. In order to enhance the cooling efficiency, these cooling holes need to be produced to a high degree of accuracy and with least defects. In this paper, a mathematical model of laser drilling is developed. The model includes effects of the vapour pressure, exothermic energy and O_2 assist gas. The analysis is based on transient heat conduction in solid and liquid regions with appropriate boundary and initial conditions at the solid-liquid and liquid-vapour interfaces. Comparison with the experimental data is presented to validate the model. The developed model enables the prediction of the hole depth, hole profile and recast layer thickness. Effects of the laser peak power and assist gas pressure are also investigated

Keywords : Laser percussion drilling, Laser drilling model, Exothermic energy, Recast layer

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