Millisecond Fibre Laser Drilling of Deep Holes

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Electrical discharge drilling is the current state-of-the-art for thick section drilling of metals and alloys. A promising alternative is the millisecond pulsed laser, which is a proven technology for high productivity drilling of cylindrical and shaped holes over metals and alloys with thickness less than 10 mm. Millisecond laser drilling process is not yet used for thick materials due to the lack of process knowledge and issues associated with hole taper and thermal damage.

This research investigates the fundamental characteristics of millisecond laser deep hole drilling (10-20 mm) of nickel superalloy. Experiments have been performed to understand the influence of various process parameters on the hole quality in both the piercing and trepanning processes, including gas composition, pulse energy, pulse duration and pulse frequency. Defects in thick section millisecond laser drilling are mostly associated with the piercing process, rather than the trepanning process. For this reason, the piercing process is studied in detail using high-speed and thermal-imaging cameras which aids the understanding of the material removal process and its effects on resultant hole quality and on subsequent trepanning process. High-quality and high-speed drilling is demonstrated with the use of the optimal gas composition for hole lengths of 20 mm with an aspect ratio of 20.