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Laser-assisted High Speed Machining of Aluminium Alloy: The Effect of Ultrasonic-induced Droplet Vegetable-based Cutting Fluid on Surface Roughness and Tool Wear

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Laser-assisted high speed milling is a subtractive machining method that employs a laser beam to thermally soften material's surface in order to enhance machinability at high material removal rate with improved surface finish and tool life. Ultrasonic-assisted milling is an advanced manufacturing technology where ultrasonic source is connected with cutting tool, that has demonstrated effectiveness in terms of acquiring good surface topography and high surface finish. Despite this, its application is limited at low speed and is not widely applied for high volume production. Here, an ultrasonic-induced droplet delivery method is employed as an efficient method for laser-assisted high speed milling operation. In this study the effect of ultrasonic-induced droplet cutting fluid on surface roughness and flank wear of 6082 aluminium alloy is experimentally investigated using response surface methodology (RSM) and the results are compared with the conventional droplet cutting fluid. The ultrasonic creates acoustic streaming, acoustic cavitation as well as cavitation bubbles in the cutting fluid. This acoustic energy is able to increase the local temperature of cutting fluid with which the laser power combinedly softens the machined surface, thereby reducing the tool abrasion and surface roughness. The results show a favourable reduction in surface roughness and flank wear by 11.04 and 1.37%, respectively, in comparison to conventional droplet cutting fluid. Clearly, the laser-assisted high speed milling with ultrasonic-induced droplet cutting fluid will be applicable in high

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