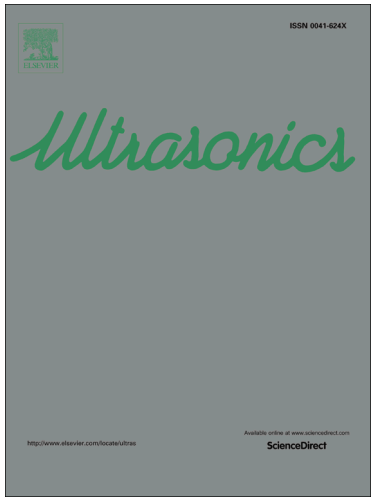

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Investigations on the critical feed rate guaranteeing the effectiveness of rotary ultrasonic machining

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Rotary ultrasonic machining (RUM) is a well-known and efficient method for manufacturing holes in brittle materials. RUM is characterized by improved material removal rates, reduced cutting forces and reduced edge chipping sizes at the hole exit. The aim of this study is to investigate the critical feed rate to guarantee the effectiveness of RUM. Experimental results on quartz glass and sapphire specimens show that when the feed rate exceeds a critical value, the cutting force increases abruptly, accompanied by a significant decrease of ultrasonic amplitude. An analytical model for the prediction of critical feed rates is presented, based on indentation fracture mechanic and the theory of impact of vibrating systems. This model establishes the theoretical relationships between the critical feed rate, idling resonant ultrasonic amplitude and spindle speed. The results predicted by the analytical model were in good agreement with the experimental results.

Keywords: Rotary ultrasonic machining, Brittle material, Material removal rate, Cutting force

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