

Core drilling of hard and brittle materials with rotary ultrasonic machine

Abstract

Ultrasonic machining (USM) is recognized to be an effective process for the precision machining hard and brittle materials such as ceramics, glass and carbides. It has also been used successfully in machining certain metals like stainless steel and titanium (Markov, 1996). USM shows the ability to produce hard and nonconductive devices with complex shapes (Guzzo et al., 2003). However, this method suffers from relatively poor accuracy; low material removal rate and substantial tool wear (Williams, 1982) due to limited capacity for circulating the abrasive slurry and simultaneous abrasion of both work piece and tool.

Rotary ultrasonic machining (RUM) is a hybrid machining process that merges the material removal mechanisms of diamond grinding and conventional ultrasonic machining. RUM shows higher material removal rates (MRR) than in both conventional diamond surface grinding under similar experimental conditions and standard USM (Thoe et al., 1998). RUM process was invented to overcome the shortcomings of USM such as more capable to drill small and deep holes with improved hole accuracy, gives superior surface finish, and machining with low tool pressure (Thoe et al., 1998; Treadwell et al., 2003). Besides, this machining process is non-thermal, non-chemical, creates no change in the microstructure, chemical or physical properties of the work piece (Williams, 1982).