

Application of Ultrasonic Assisted Machining Technique for Glass-Ceramic Milling

Authors : S. Y. Lin, C. H. Kuan, C. H. She, W. T. Wang

Abstract : In this study, ultrasonic assisted machining (UAM) technique is applied in side-surface milling experiment for glass-ceramic workpiece material. The tungsten carbide cutting-tool with diamond coating is used in conjunction with two kinds of cooling/lubrication mediums such as water-soluble (WS) cutting fluid and minimum quantity lubricant (MQL). Full factorial process parameter combinations on the milling experiments are planned to investigate the effect of process parameters on cutting performance. From the experimental results, it tries to search for the better process parameter combination which the edge-indentation and the surface roughness are acceptable. In the machining experiments, ultrasonic oscillator was used to excite a cutting-tool along the radial direction producing a very small amplitude of vibration frequency of 20KHz to assist the machining process. After processing, toolmaker microscope was used to detect the side-surface morphology, edge-indentation and cutting tool wear under different combination of cutting parameters, and analysis and discussion were also conducted for experimental results. The results show that the main leading parameters to edge-indentation of glass ceramic are cutting depth and feed rate. In order to reduce edge-indentation, it needs to use lower cutting depth and feed rate. Water-soluble cutting fluid provides a better cooling effect in the primary cutting area; it may effectively reduce the edge-indentation and improve the surface morphology of the glass ceramic. The use of ultrasonic assisted technique can effectively enhance the surface finish cleanness and reduce cutting tool wear and edge-indentation.

Keywords : glass-ceramic, ultrasonic assisted machining, cutting performance, edge-indentation

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