ENHANCEMENT OF SURFACE INTEGRITY IN CRYOGENIC HIGH SPEED BALL NOSE END MILLING PROCESS OF INCONEL 718

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Abstract:
Surface integrity of machined subsurface in any machining process has become an important aspect because of increased quality demands especially in high accuracy demand industries like aerospace, automotive, defense and medical applications. The attention of these industries is to achieve a good surface roughness, avoid plastically deformed layer and most cases increasing the hardness at the subsurface area for robust application. As is known, Inconel 718 is a difficult-to-machine material and it is often used in the manufacture of turbine gas and jet engines for aerospace applications. In most cases, Inconel 718 machining will be resulting an excessive heat generated at the cutting zone. This can cause in a variety of problems during machining such as rapid tool wear, damage on machined surface and microstructural defects. Hence, various cooling methods have been made to address these problems and improve the quality of machined surface. In this study, a cryogenic cooling technique using nitrogen liquids (LN2) was developed to cool the tool-chip interface during milling Inconel 718. The goal of this paper is to presents a comparison study on surface roughness, machined surface microhardness and subsurface microstructure changes between cryogenic cooling and dry techniques. The experiments conducted using a PVD coated with TiAlN/AlCrN ball nose tungsten carbide for varying cutting speeds ranging between 140–160 m/min, a feed rate of 0.15-0.20 mm/tooth, and radial depth of cut of 0.2-0.4 mm. The results revealed that the cryogenic cooling technique is more effective than dry cutting for improving surface roughness and lessening deformation of microstructure changes underneath the machined surface. However, machining in dry technique has produced a high microhardness for machined surface compared to cryogenic cooling technique. Overall, the utilization of the cryogenic technique has improved the surface roughness to a maximum of 88% and reduced the plastic deformation layer, while dry machining can improve the surface microhardness up to 5%.

Keywords : Surface Integrity; Cryogenic; End Milling; Inconel 718

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