HIGH SPEED GRINDING OF PARTICULATE REINFORCED TITANIUM MATRIX COMPOSITES USING MONOLAYER BRAZED CBN WHEEL

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1. Introduction

Particulate reinforced titanium matrix composites (PTMCs) are advanced structural materials owing to their excellent mechanical properties in terms of specific strength and wear resistance. However, it is very difficult to machine PTMCs due to high hardness and brittleness of the TiC reinforcing particles, and high strength and toughness of the Ti-6Al-4V metallic matrix. The monolayer brazed CBN superabrasive wheels have been broadly utilized to grind difficult-to-cut materials owing to their high grain protrusion and favorable grain distribution. High speed grinding of PTMCs is carried out using a brazed CBN wheel. The grinding performance is examined and evaluated comprehensively in terms of grinding forces, grinding temperatures, surface defects and subsurface characteristics, which is expected to provide a feasibility of high-efficiency and low-damage grinding of PTMCs.

2. Experimetal Results and discussion

The materials utilized for grinding test were PTMCs (TiCp/Ti-6Al-4V) containing approximately 10 vol.% TiC reinforcing particles with the size of 1.2-8.4 μm and the average quantity about 1500 /mm^2.The grinding experiments were conducted on a surface-grinder, BLOHM PROFIMAT MT-408. A monolayer brazed CBN wheel with 400 mm in diameter and 7 mm in width was utilized. The grains size was 80/100# (mesh size). The interval of the adjacent grain rows was 1.2 mm.

The grinding forces and temperature are generally increased with increasing of the depths of cut and workpiece infeed speeds. As the workpiece infeed speed is fixed at 6 m/min, and the depths of cut is increased from 0.005 mm to 0.020 mm, the normal forces Fn are increased from 29.9 N to 47.3 N (by 58%), the tangential forces Ft are increased from 7.3 N to 10.5 N (by 44%), and the grinding temperature T is increased from 433 ℃ to 713 ℃ (by 65%). As the depth of cut is kept constant at 0.010 mm, with increasing of the workpiece infeed speeds from 3 m/min to 12 m/min, the normal forces are increased from 31.8 N to 44.2 N (by 39%), the tangential forces are increased from 7.8 N to 10.9 N (by 40%), and the grinding temperature is increased from 489 ℃ to 645 ℃ (by 3 The quantities of pores with an area of below 5 μm^2 are almost identical, which are 80-90 /mm^2. For the pores with a larger area, especially for >10 μm^2, the pores quantities are much significantly increased with increasing of grinding parameters. It is from merely 5 /mm^2 at the workpiece infeed speed of 3 m/min and the depth of cut of 0.010 mm, to 20 /mm^2 at the workpiece infeed speed of 6 m/min and the depth of cut of 0.010 mm, and finally to 70 /mm^2 at the workpiece infeed speed of 6 m/min and the depth of cut of 0.020 mm. According to the microhardness alteration region, the depth of the affected subsurface layer could generally be regarded as below 300 μm even if the materials removal rate arrives at 2 mm^3/(mm•s). The increase magnitude of the microhardness in the grinding-induced subsurface layer is ranged from 0.1% to 6.4%, and the depth of the crystal lattice distortion region is changed from 6.6 μm to 14.8 μm.

3. Conclusions

The grinding forces and temperature generally increase with increasing of the depths of cut and the workpiece infeed speeds. The quantities of the pores is greatly influenced by the grinding parameters. The defects introduced into the PTMCs workpiece surface do not extend to the subsurface layer. Smaller grinding parameters always results in the thinner subsurface layer and the smaller increase magnitude of microhardness. The combination of brazed CBN wheels and high speed grinding technique is in favor of high-efficiency and low damage grinding of PTMCs.

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