Microstructural evolution of titanium alloy (Ti-6Al-4V) after metal cutting assisted by high pressured jet cooling

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Titanium alloys are used in aerospace industry owing to their high strength to weight ratio but difficult to machine. High-pressure jet–assisted machining of titanium alloys is beneficial. It increases productivity and improves the properties of the work-piece.

The titanium alloy used in the present study was Ti-6Al-4V consisting of predominantly α-Ti ($P6_3/mmc$) [1]. The Ti-6Al-4V rod was machined using both conventional and high-pressure jet–assisted methods. The depth profile of residual stress was measured using x-ray diffraction. It was found that the compress residual stress is higher and the deeper under which the compress residual stress exists, for sample cut by high-pressure jet–assisted than for sample cut by conventional method [2].

Using transmission electron microscopy the cross-section of the surface layer was found to consist of a thin outer layer with nano-sized crystals (~10 nm) and the substrate of large grains with very high density of dislocations. Electron diffraction reveals that the nano-sized outer layer is highly textured. Furthermore, the study shows that the nano-sized layer has twice the thickness for the high-pressure jet–assisted cut sample (~1,000 nm) than for the conventionally cut sample (~500 nm). This shows that high-pressure jet–assisted cutting resulted in a thick and highly modified outer layer and provides an explanation for the large and deep compressed residual stress after high-pressure jet–assisted cutting of Ti-6Al-4V.

[1] PDF File No.44-1294. [2] Vosough M., Liu P., Svenningsson I., *Mat. Sci. Forum*, 2005, **490-491**, 545-551.

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