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# Material removal mechanism and surface integrity in ultraprecision cutting of porous titanium

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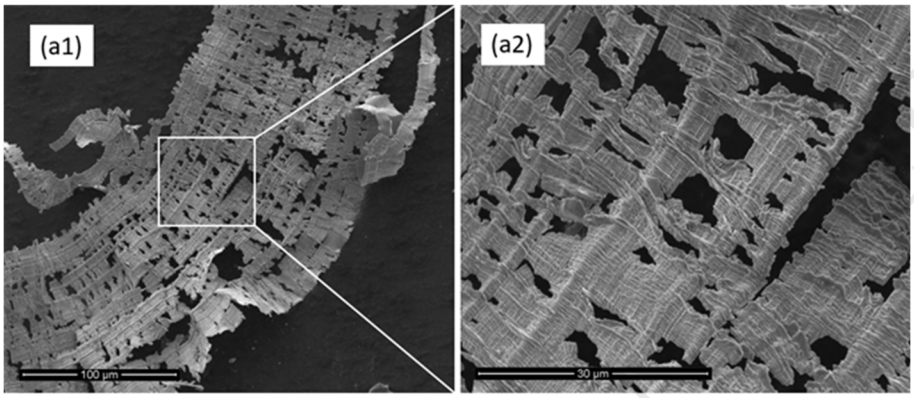
Graphical Abstract




SEM photographs of chips formed during porous titanium cutting

Highlights

- Chip morphology and surface topography depend on pore size and location.
- Pores act as sources for chip tearing and crack propagation.
- Pore closing leads to an average porosity drop from ~30% to 1%.
- The use of coolant has double-face effects on cutting force.
- Pores help suppressing tool wear especially in wet cutting.

**Abstract**

Porous titanium presents unique material properties with a wide variety of mechanical and biomedical applications. Porous titanium components fabricated by near net-shape technologies require further machining processes to improve the surface quality and form accuracy, and in turn, the added value of the products. In this work, major factors dominating the surface integrity in ultraprecision cutting of porous titanium using single-crystal diamond tools were investigated. The results demonstrated that the presence of pores significantly changed mechanism of cutting. The chip morphology and surface topography depended on pore size and undeformed chip thickness. At an extremely small undeformed chip thickness, a majority pores were closed due to the welding phenomenon, leading to a sharp drop of surface porosity. In contrast, large pores cause craters on the machined surface and segmentation of chips and protruding lamella, especially at a large undeformed chip thickness. A coolant could