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Title: Wear mechanism of single cBN-WC-10Co fiber cutter in machining of Ti-6Al-4V alloy

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Abstract: In order to explore the wear mechanism of single cBN-WC-10Co fiber cutter in machining of Ti-6Al-4V alloy, this study performs scratch tests, and develops a theoretical model based on the evaluation of cutting performance. The scratch and wear morphologies of the fiber cutter are analyzed by an optical profilometer and scanning electron microscopy (SEM). The wear behavior of the fiber cutter is evaluated comprehensively in terms of cutting forces, the wear morphology of fiber and the profile of scratches with respect to cutting passes. The presented study finds that the wear of the single fiber cutter shows three types, i.e., (1) wear at the cutting edge; (2) abrasion on the local flank face; and (3) abrasion on the new flank face. The identified types of the wear are progressed at three wear stages with different cutting passes. Furthermore, when the number of cutting passes is increased from 1 to 65, the pile-up ratio is increased from 0.11% to 9.95%; while the surface roughness over the scratch is increased from 1.30 μm to 3.73 μm . Accompanying by the increase of cutting passes and the growth of the fiber wear, the cutting force and the normal to tangential force ratio are gradually increased. The machining efficiency and the quality of the machined surfaces are decreased when the local flank face or the new flank face is developed. The mechanical model of the single fiber cutter is established for the machining of Ti-6Al-4V alloy, and a theoretical wear model is developed to give the rationales of the acquired data of wear and cutting forces from experiments.

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