Evolution of Tool Wear and Machining Quality during Dry Milling of $AlCoCrFeNi_{2.1}$ Eutectic High Entropy Alloy

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$AlCoCrFeNi_{2.1}$, a new class of eutectic high entropy alloy (EHEA) has drawn significant interest owing to the lamellar structure of alternating FCC and B2 phases. Properties such as high strength and high plasticity render the machining of this alloy challenging. Addressing this issue, milling experiments were conducted under dry conditions to investigate the machining quality of $AlCoCrFeNi_{2.1}$ EHEA as well as the tool wear. The cutting temperature and cutting forces were measured. The tool wear mechanisms and modes evolution under different parameters were clearified. In addition, the changes in surface topography under different cutting parameters were analyzed. The results show that the width of flank wear increases with the increase of the cutting speed and the feed rate. The tool wear modes evolved differently with different cutting parameters, for instance, abrasive wear dominated while the cutting speed was less than 80 m/min, but for higher speeds upto 110 m/min, adhesive wear and coating peeling occurred. As the cutting speed increases further, crater wear on the rake face starts to arise in addition to the flank wear. Abrasive wear and adhesive wear with increasing feed rate were dominant until a certain threshold (0.10 mm/tooth) beyond which the coating peels off the tool. Furthermore, chipping occurred for a higher feed rate of 0.14 mm/tooth. In terms of machining quality, larger cutting parameters will worsen the surface roughness and topography as well as lead to deeper subsurface plastic flow.