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Synthesis and Tribological Properties of the Al-Cr-N/MoS_2 Self-Lubricating Coatings by Hybrid Magnetron Sputtering

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Abstract : Ternary AlCrN coatings were widely used to prolong cutting tool life because of their high hardness and excellent abrasion resistance. However, the friction between the workpiece and cutter surface was increased remarkably during machining difficult-to-cut materials (such as superalloy, titanium, etc.). As a result, a lot of cutting heat was generated and cutting tool life was shortened. In this work, an appropriate amount of solid lubricant MoS_2 was added into the AlCrN coating to reduce the friction between the tool and the workpiece. A series of Al-Cr-N/MoS_2 self-lubricating coatings with different MoS_2 contents were prepared by high power impulse magnetron sputtering (HiPIMS) and pulsed direct current magnetron sputtering (Pulsed DC) compound system. The MoS_2 content in the coatings was changed by adjusting the sputtering power of the MoS_2 target. The composition, structure and mechanical properties of the Al-Cr-N/MoS2 coatings were systematically evaluated by energy dispersive spectrometer, scanning electron microscopy, X-ray photoelectron spectroscopy, X-ray diffractometer, nano-indenter tester, scratch tester, and ball-on-disk tribometer. The results indicated the lubricant content played an important role in the coating properties. As the sputtering power of the MoS_2 target was 0.1 kW, the coating possessed the highest hardness 14.1GPa, the highest critical load 44.8 N, and the lowest wear rate 4.4×10−3μm2/N.

Keywords : self-lubricating coating, Al-Cr-N/MoS_2 coating, wear rate, friction coefficient
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