

Synthesis and Tribological Properties of the Al-Cr-N/MoS₂ 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 MoS₂ was added into the AlCrN coating to reduce the friction between the tool and the workpiece. A series of Al-Cr-N/MoS₂ self-lubricating coatings with different MoS₂ contents were prepared by high power impulse magnetron sputtering (HiPIMS) and pulsed direct current magnetron sputtering (Pulsed DC) compound system. The MoS₂ content in the coatings was changed by adjusting the sputtering power of the MoS₂ 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 MoS₂ 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 $4.4 \times 10^{-3} \mu\text{m}^2/\text{N}$.

Keywords : self-lubricating coating, Al-Cr-N/MoS₂ coating, wear rate, friction coefficient

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