Metastable hard (V,Al)N thin films by magnetron sputtering

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Transition metal nitride coatings with metastable microstructure, e.g. (Ti,Al)N and (Cr,Al)N are well established as hard protective and tool coatings. Progress in mechanical, friction and tribological properties can be achieved by designing new metastable thin film materials offering superior functionalities. V-Al-N thin films could be suitable candidates in this respect as both V and Al can form protective and lubricious oxide scales under high thermal load. We report in detail on the synthesis and characterization of V-Al-N thin films. These thin films were deposited onto cemented carbide substrates both by non-reactive and reactive magnetron sputtering utilizing a segmented V:Al target. The substrate bias, the target power, and the gas flows were varied systematically. Over a wide range of chemical composition single phase metastable $(V_{1-x}, Al_x)_yN_{1-y}$ thin films ($0.03 \leq x \leq 0.47$, and, $0.49 \leq y \leq 0.66$) with face centered cubic microstructure were grown. The formation of a hexagonal wurtzite phase was not observed. Depending on the V:Al concentration ratio and the synthesis parameters, the metastable f.c.c. thin films exhibited hardness values between 1743 and 2661 HV, indicating an significant potential for application as wear-resistant coatings.

Symposium: C4.I Protective Coatings and Thin Films