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SYMPOSIUM B - Hard Coatings and Vapor Deposition Technology

B6. HARD AND MULTIFUNCTIONAL NANO-STRUCTURED COATINGS

Characterization of binary, ternary and quaternary hard coatings in the material system V-Al-C-N produced by industrial scale reactive magnetron sputter deposition

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Binary, ternary and quaternary hard coatings in the system V-Al-C-N (VN, AlN, VC, VAlN and VAlCN) were deposited by industrial-size/industrial scale reactive d.c. and r.f.-magnetron sputtering in an Ar/N and an Ar/CH_4 plasma from a V target and/or Al target, respectively from an VAl_{20}-target (V target with 20 Al-plugs). For each experiment, Si (100) substrates and polished 1.2379 steel substrates were placed on the rotating substrate table with variable rotation speed and rotation axes. VN coatings were deposited at a constant Ar gas flow of 250mln, while the bias voltage applied to the substrate table was systematically varied between -80 and -200V. VC coatings were deposited at constant Ar:CH_4 gas flow ratio (250:60) and systematically varied bias voltage between -80 and -200V and respectively at constant bias voltage from -170V and varied Ar:CH_4 ratio through changing the CH_4 amount in the plasma. For the deposition of AlN, VAlN and VAlCN coatings the bias voltage, the Ar:N ratio and the total gas pressure were varied. The chemical composition of the obtained coatings was determined by electron microprobe analysis and the crystal structure of the films was characterized by X-ray diffraction. The influence of the process parameter variation on the mechanical properties hardness, reduced elastic modulus and critical load of failure have been studied by microindentation and scratch test. The surface roughness of the as-deposited samples was examined as a function of the initial substrate surface roughness. It was possible to achieve a large variation in the hardness in the range from 700$HV_{0.005}$ to 3100$HV_{0.005}$ and in the coefficient of friction in the range from 0.2 to 0.7. Finally, the specific conditions for the formation of large-area VN, AIN, VC, VAlN and VAlCN nanoscale coatings in industrial-size coating facilities are described in terms of process engineering.