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Influence of HPPMS on Hybrid dcMS/HPPMS (Cr,Al)ON processes

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In plastics industry injection molding and extrusion tools are subjected to adhesive and abrasive wear. Therfore, chromium-based nitride hard coatings deposited by physical vapor deposition (PVD) are applied as protective coatings. In the deposition of these coatings hybrid direct current and high power pulse magnetron sputtering dcMS/HPPMS processes can be used in order to benefit from both processes. While dcMS provides a considerable higher deposition rate, coatings deposited by HPPMS usually exhibit a significantly higher hardness and show a more dense morphology and a smoother surface. In the presented work, different nitride and oxynitride coatings deposited by using an industrial scale coating unit on tool steel AISI 420 were investigated. Aim of the investigations was to quantify the influence of HPPMS on the hybrid dcMS/HPPMS process within the coating plasma and to correlate it with the coating properties. At first, the coating plasma was analyzed using HPPMS and hybrid dcMS/HPPMS processes. Changes in the plasma composition were investigated by optical emission spectroscopy (OES). The ion current density and ion energy distribution were investigated by retarding field energy analyzer (RFEA). Then, (Cr,Al)N and (Cr,Al)ON coatings were deposited using the same process parameters. The coatings were analyzed regarding the microstructure by scanning electron microscopy (SEM) as well as the hardness and the indentation modulus by nanoindentation. Furthermore, the chemical composition of the coatings was analyzed by X-ray photoelectron spectroscopy (XPS) and electron probe microanalysis (EPMA). Using innovative nanoscratch tests, the plastic deformation of the coatings was investigated. By comparing the measurements, data of the influence of HPPMS within the dcMS/HPPMS hybrid process on the plasma were revealed and correlated with the coating properties morphology, hardness, as chemical composition and plastic deformability.

Keywords
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