

TiZrN-based coatings for dry machining deposited by dual-beam EB-PVD

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TiZrN-based hard coatings are attractive candidates for dry machining applications, but their deposition via electron-beam physical vapor deposition is typically limited by markedly different evaporation rates between Ti and Zr. In this study, TiZrN-based coatings were developed on AISI H13 (DIN 1.2344) steel substrates using a plasma-assisted dual-beam EB-PVD process. Such coatings were investigated for the long-term objective of enabling multifunctional Ti-Zr coating systems, such as TiZrCrN, but initial trials showed preferential Ti evaporation from the melt pool, generating a Ti-rich vapor flux and restricting Zr incorporation. To avoid Zr-depleted coatings, Ti-Zr targets with varied Ti:Zr ratios were investigated to compensate for the differential evaporation and to achieve compositionally controlled TiZrN-based coatings. The deposited coatings were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX) nanoindentation and pin-on-disk tribology, with emphasis on the correlation between composition, microstructure, mechanical properties, and wear behavior relevant to dry-machining conditions. By treating source chemistry as an active process-control variable, the study aims at providing an EB route towards compositionally controlled TiZrN-based coatings for lubricant-free machining.

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