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ACCEPTED MANUSCRIPT

Nano-structural investigation of Ti-Al-N/Mo-Si-B multilayer coatings: A comparative study by APT and HR-TEM

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Abstract

Nano-composites often represent a challenge for spatially resolved analysing methods. The overlap of specific signals, for example in the mass-to-charge spectrum during atom probe tomography (APT) analysis or the intersection of electron energy loss edges in electron energy loss spectroscopy (EELS), leads to highly challenging results. Therefore, a complementary use of different techniques is essential to fully characterise a given system. Within this work, we studied our TiAlN/MoSiB multilayer (comprising alternating 31nm thin arc evaporated fcc-Ti_{0.57}Al_{0.43}N layers and amorphous 6nm thin Mo_{0.58}Si_{0.28}B_{0.14} layers), by high-resolution transmission electron microscopy, EELS as well as APT and completed the results by comprehensive X-ray diffraction measurements. We focused on the microstructure and crystallographic evolution during thermal loading - up to 1400°C - and hence a detailed analytical description applying a wide set of high resolution techniques. When exposed to high temperatures, the as-deposited amorphous MoSiB layers form the oxidation resistant, intermetallic phases T₁-Mo₅Si₃ and T₂-Mo₅SiB₂. The layered arrangement between TiAlN and MoSiB allows to postpone the formation of the comparative soft, hexagonal wurtzite type AlN (due to the decomposition of fcc-Ti_{1-x}Al_xN layers) up to 1200°C, which is by ~200-300°C above the typical formation temperature of w-AlN in homogeneously grown single phase fcc-Ti_{1-x}Al_xN thin films.

Keywords: Hard Coatings; Ti-Al-N; Mo-Si-B; Atom Probe Tomography (APT); HR-TEM; Spatially Resolved Analysis

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