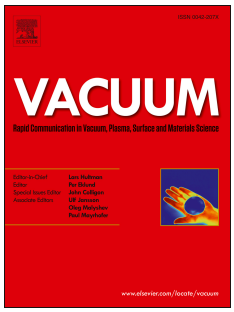
Accepted Manuscript



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PII: S0042-207X(18)31467-2

DOI: 10.1016/j.vacuum.2018.08.037

Reference: VAC 8184

To appear in: *Vacuum*

Received Date: 2 August 2018

Revised Date: 16 August 2018

Accepted Date: 21 August 2018

Please cite this article as: Aschauer E, Sackl S, Schachinger T, Wojcik T, Bolvardi H, Arndt M, Polcik P, Riedl H, Mayrhofer PH, Nano-structural investigation of Ti-Al-N/Mo-Si-B multilayer coatings: A comparative study by APT and HR-TEM, *Vacuum* (2018), doi: 10.1016/j.vacuum.2018.08.037.

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 T_1-Mo_5Si_3 and T_2-Mo_5SiB_2. 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