SMALL SCALE FRACTURE OF MULTI METAL CARBIDE COATINGS

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The micromechanical behavior of sputtered multi metal carbide (Hf-Nb-Ta-Zr)C coatings was investigated. A equiatomic high entropy alloy (Hf-Nb-Ta-Zr) and high density graphite were used as targets to reactively sputter carbide coatings on Si (100) with a silicon nitride buffer layer at different substrate temperatures (RT, 300, 450, 600 and 750 ^{0}C). Energy and wavelength dispersive x-ray spectra confirmed that the metal compositions were equiatomic with a carbon content close to stoichiometric value. X-ray diffraction revealed that a single phase with a rocksalt structure was obtained for all deposition conditions. Furthermore, XRD measurements highlighted that crystallinity improved markedly with increasing deposition temperatures and the magnitude of compressive stresses reduced, concomitantly. For the highest temperature, tensile stresses of 500MPa was noted. Optical microscopy also revealed extensive mud cracking of the film deposited at 750°C, consistent with high tensile stresses. Microstructures characterized by transmission electron microscopy revealed columnar grains with nanocrystalline dimensions. Coatings deposited at 600°C showed the highest hardness and indentation modulus of 32 and 350 GPa, respectively, measured with the continuous stiffness mode. Focused ion beam machining is used fabricate micro cantilever which are tested in situ in a SEM to evaluate fracture properties of these complex carbide coatings. Nanoindentation based toughness measurements are underway to compare toughness estimates these two techniques.