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Influence of the microstructural and chemical composition of nanostructured CrAl(Y,Zr)N coatings on the oxidation resistance

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Magnetron sputtered chromium aluminium nitride films are excellent candidates for advanced machining and protection for high temperature applications. In this work CrAl(Y/Zr)N coatings are deposited by d.c. reactive magnetron sputtering on M2 steels and silicon substrates using metallic targets and Ar/N_2 mixtures. The influence of the incorporation of Y and Zr as dopants (content ≈ 2 at. %) in terms of oxidation resistance is studied by means of X-ray diffraction (XRD), cross-sectional scanning electron microscopy (X-SEM) and energy dispersive X-ray analysis (EDAX). The chemical bonding and microstructure are investigated using a transmission electron microscope (TEM) and electron energy-loss spectroscopy (EELS) respectively. The hardness properties are found in the range of 30-32 GPa with H/E ratios close to 0.1. Compressive residual biaxial stresses are below 0.5 GPa. Optimizing the Al/(Cr+dopant) ratio an improvement of the oxidation resistance above 1000ºC is pursued. The improvement in oxidation resistance is explained in terms of nanostructure, film structure and chemical composition. The formation of chromium oxide layer, nitrogen removal and grain growth are reduced significantly influenced by the incorporation of the dopants.

Keywords
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