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Chemical, mechanical and stability of air annealed cathodic arc evaporated CrAlON coatings

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This study reports the synthesis and characterization of ternary and quaternary and multilayered Cr-Al-O-N coatings deposited by cathodic arc physical vapour deposition, as a function of the nitrogen and oxygen mass flow ratios during the process. The composition, microstructure, indentation hardness and modulus of the films have been characterized by scanning electron microscopy, electron probe micro analysis, x-ray diffraction, and nano-indentation techniques. The thermal stability of the coatings in ambient air at 1100ºC have been investigated, and their evolution with the annealing temperature. As the oxygen to nitrogen mass flow increases, the coatings as-deposited exhibit lower hardness, higher roughness, lower crystallinity and a more marked columnar structure. At oxygen to nitrogen mass flow ratios bigger than 10/90, the coatings exhibit a stoichiometry $(CrAl)_{2+e}O_{3-e}$. Only the coatings with oxygen to nitrogen mass flow ratios smaller than 10/90 presented nitrogen in their compositions. In all cases, the coating developed cubic fcc lattice structures. After the annealing at 1100ºC the resulting microstructure showed a clear dependency upon the initial composition and architecture of the films. The evolution of the microstructure for the temperature series as well as the analysis of the indentation hardness, composition and thickness also provided valuable information about the thermal stability of the deposited coatings. Both the oxide pristine coatings and the multilayered architechtures exhibit an outstanding mechanical stability up to 1100ºC.

Keywords
Cr-Al-O-N
arc evaporation
PVD