39) Journal of Alloys and Compounds

Volume 776, 5 March 2019, Pages 679-690

Multilayered ZrN/CrN coatings with enhanced thermal and mechanical properties(Article)

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Краткое описание Просмотр пристатейных ссылок (73)

Multilayered ZrN/CrN coatings were produced by the cathodic arc physical vapor deposition (CA-PVD). Morphology, element distribution, structural and thermal properties were investigated. Microhardness and nanoindentation tests were conducted to study the mechanical properties of the coatings. The experimental results of scanning electron microscopy (SEM) revealed the cellular microrelief of the surface and well-defined multilayered architecture of the coatings. Energy dispersive spectroscopy (EDS) provided the chemical characterization of the coatings and revealed the formation of stoichiometric composition in coatings. X-ray diffraction (XRD) studies showed that (200) and (111) plane reflections of ZrN and Cr2N phases, correspondingly, were with maximum intensity. Transmission electron microscopy (TEM) analysis revealed that the films comprise of nanometric equiaxed grains with average sizes from 12.8 to 15.1 nm for ZrN layers and from 14.5 to 28.1 nm for CrN layers. The high-temperature heat treatment caused exothermic and endothermic reactions, which were mainly attributed to the improvements or disordering of the coatings' structure, consequently. The highest values of microhardness (4966HV0.025) and nanohardness (24.58 GPa) were obtained for the sample with a bilayer thickness of 732 nm, the average crystallite size of 13.3 nm and nitrogen content of 49 at%. Experimental results indicated that deposited composites can be effectively used in the production of industrial tools, implements for cutting etc.