74) High Temperature Material Processes

Volume 23, Issue 3, 2019, Pages 221-237

High-temperature in situ DSC studies of multilayer ZrN/CrN coatings obtained by CA-PVD(Article)

Maksakova, O.V.a, Pogrebnjak, A.D.a, Beresnev, V.M.b, Plotnikov, S.V.c, Simoẽs, S.d View Correspondence (jump link)

aSumy State University, 2 Rimsky-Korsakov Str., Sumy, 40007, Ukraine

bV.N. Karazin Kharkiv National University, 4 Svoboda Sq., Kharkiv, 61022, Ukraine

cD. Serikbayev East Kazakhstan State Technical University, 69 Protozanov Str., Ust-Kamenogorsk, 070004, Kazakhstan

The thermal stability of cathodic arc evaporated ZrN/CrN multilayer coatings was specially investigated by differential scanning calorimetry. The investigated coatings had a coarse surface structure. Good uniformity of alternating layers of ZrN and CrN was observed in the cross-section images. It was clearly seen that at first the layers repeated the relief of the substrate but subsequently they were aligned during consequent growth of the film. According to the analysis of the elemental composition, the ZrN layers had a higher content of N than the CrN layers as the nitrogen has a stronger affinity for zirconium than chromium. An analysis of the diffractograms obtained from investigated multilayers revealed the presence of two phases: ZrN and CrN or ZrN and Cr2N + CrN that corresponded to the deposited layers. In the ZrN and CrN layers the crystallites with preferred orientation axes [100] and [111], respectively, were formed. The changes in phase transformations and thermal properties were registered during heating and consequent cooling cycles within the temperature range from 30 to 1400°C in argon flow. During heating, the exothermic reactions started at around 620 or 1100°C and pointed out the phase transformations in the CrN layers. The phase transformations improved the structural order of the systems and caused a uniform growth of crystallites. It was obvious that the resistance of the multilayer coatings to high temperatures was influenced by the deposition parameters and elemental composition. The maximum enthalpy of –286.97 J/g was reached at the exothermic reaction.