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DEPENDENCE OF GRAIN SIZE ON TEMPERATURE IN A LAYER OF COATING BASED ON Zr-Y-O in A MULTILAYER COATING Zr-Y-O / Si-Al-N.

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Mechanical properties of zirconium dioxide ceramics are known to be the function of phase composition and structure. Tetragonal zirconium dioxide possesses high strength and toughness. Various methods and technologies were improved for production and stabilization of the tetragonal phase of the zirconium dioxide material. The most common method is the production of tetragonal zirconia by adding to it some stabilizing compounds. Analysis of published data shows that the yttrium oxide Y_2O_3 is commonly used as a stabilizing agent, which contributes to transformation of the tetragonal phase to monoclinic one at cooling.

A special attention is paid to reversible martensitic transformations in metal alloys (the so-called transformational conversion) due to the potential of their practical use in many fields of science, technology, medicine and industry. These alloys belong to the group of the so-called "smart" functional materials, as they allow controlling their behavior. These are transformation-hardening materials which are widely used in engineering practice as structural materials. The majority of such ceramic materials are developed on the basis of zirconium dioxide that is partially stabilized in the tetragonal phase. The tetragonal phase is capable of a monoclinic martensitic phase transition. The phase transition is accompanied by development of the shear and volume strain, stress relaxation, and closure of surface cracks. The hardening effect can result in ceramic materials with the strength properties (fracture toughness and strength) comparable to that of structure materials.

Deposition of the coatings was carried out in the KVANT-03MI unit equipped with a magnetron with a mosaic zirconium-yttrium target. The magnetron was powered from a pulse source at the frequency of 50 kHz. The samples were placed in the chamber on the rotating table. The sample temperature during the deposition was 573K.

The structural-phase state of the surface layers of the copper substrate was investigated by high temperature transmission electron microscopy (TEM) using the JEM-2100 microscope (Jeol Ltd., Japan).

By SEM and TEM it has been established that coatings on the basis of Zr-Y-O produced by the magnetron sputtering methods have a nanograin column structure where the columns are spread through the entire coating thickness.

In the initial state layers on the basis of Zr-Y-O are two-phase and consist generally of the tetragonal phase ZrO_2 with a small amount of monoclinic one.

At heat When sample is heated in a "in-situ" mode in a Zr-Y-O layer of a multilayer Zr-Y-O / Si-Al-N coating in the 400-475 C temperature range, a martensitic phase transition of the tetragonal ZrO2 phase to the monoclinic

On heating of ZrO_2 samples in a column of TEM in the “in-situ” mode we can observe: 1) turns of grains of the main phase together with change in the angle of disorientation crystallographic planes; 2) martensitic transition of the tetragonal phase to the monoclinic at temperature of 450-475^{0}C; 3) modification of grain boundaries– their total length increases, the form of grains changes, in initial column grains there are cross boundaries, i.e. there is a process of fragmentation of grains.

The results were obtained using equipment of Center of collective use “NANOTECH” of ISPMS RAS (CCU TSC SB RAS)

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