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THE EFFECT OF GRAIN BOUNDARIES ON THE ELASTIC AND THERMO-PHYSICAL PROPERTIES OF METAL-CERAMICS COMPOSITES

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Cermets (metal-ceramic composites) are modern construction materials used in different branches of industry. Their toughness and heat resistance are determined by their elastic and thermo-physical properties. In addition, these properties are significantly dependent on the grain boundaries in the material. These boundaries are formed in the sintering process. In this work, cermets based on corundum and stainless steel (sintered in a high vacuum at temperatures of 1500-1600 °C) was investigated. The volume of steel in the samples varies between 2 and 20 vol %. The elastic moduli were measured by the ultrasonic method at room temperature; measurement of the thermal conductivity coefficient was carried out at temperatures of 100 and 200 °C, by a method of continued heating in an adiabatic calorimeter. We found two extremes for the dependence of the elastic moduli (E and G) on the stainless steel concentrations, the nature of which is unknown. The moduli values changed in the ranges of E=110-310 and G=60-130 GPa (for different temperatures of sintering). Similar dependence is observed for the thermal conductivity coefficient with values varying by 10 to 40 relative units. A discussion of the results based on the structure cermet model as multiphase micro heterogeneous media with isotropic physical properties is also presented. The purpose of this work was to search the formation of grain boundaries in metal-ceramics composites at various metal concentrations and sintering temperatures; to study the influence of these boundaries on elastic moduli and thermo conductivity and to find the coupling of these properties, to estimate the optimal value of the metal concentration for achieve high quality of ready composites corundum-stainless steel.

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