Nanostructured surfaces

Kinetics dispersion-coagulation during annealing in vacuum niobium and hafnium nanofilms deposited onto non-metallic materials

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Joining ceramics and other non-metallic materials (sapphire, monocrystals, etc.) with metals by brazing using metallic brazes or pressure welding joining using deformable metal gasket found wide applying in modern technique. For manufacturing of qualitative materials joining by brazing or pressure welding metallic materials are often has been coated by different metals films.

Perspective is the use of adhesive-active metals niobium and hafnium in the form of thin films, particularly nanofilms, which gives the opportunity to develop fabrication technology of precision and strong dissimilar materials joints with very fine brazing seam.

In this work the kinetics of dispersion-coagulation during annealing in vacuum of niobium and hafnium nanofilms deposited onto oxide materials (sapphire, ceramics on base Al_2O_3 and ceramics on base ZrO_2) was investigated by metallography, scanning electronic microscopy and atomic-power one methods. It was found that these films deposited onto oxides have almost no changes its structure during annealing up to 1400 C, and under further rise annealing temperature films disintegration process was intensified significantly. This disintegration of films on given oxides has approximately the same character and almost finished as a result of annealing up to 1600 C for 20 min with simultaneous coagulation of small film fragments into larger conglomerates. The intensity of niobium films dispersion onto investigated oxides is slightly higher compared to hafnium films. This phenomenon can be explained by different affinity for oxygen of these metals.

The results can be used to develop technology manufacturing of high temperature joining of non-metallic materials by brazing or diffusion bonding using niobium and hafnium nanofilms as metallization coatings.