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DESTRUCTION OF CERAMICS BASED ON ZrO_2 UNDER MECHANICAL IMPACT

The article considers the technology of manufacturing of ceramic samples based on zirconia partially stabilized with yttrium oxide. Specimens of the ceramics based on zirconia partially stabilized by yttrium oxide of the composition of 97 mol.% ZrO_2 + 3 mol.% Y_2O_3 were prepared. The ceramics mainly have the tetragonal structure (95–98 wt% of *t*-ZrO_2). The densities of the specimens were 6.01 g/cm^3. Mechanical impact on the ceramics activates transformation of the tetragonal phase into the monoclinic one near the fracture surfaces: at the abrasive cutting or at the fracture by hammer shock, the content of the monoclinic phase increases. The same trend was observed in the specimens recovered after shock compression up to 36 and 52 GPa. Microstructure of the fracture surfaces was studied by means of scanning electron microscopy. The crystal structure was studied by means of X-ray phase analysis. Fractional composition of the starting powder was examined by atomic force microscopy. The recovered specimens did not reveal any traces of the phase change accompanying the reduction of specific volume, which was reported by Mashimo et al. under the pressures of 30–35 GPa. The samples were immersed in liquid nitrogen (15 min) in liquid helium (15 min). Phase composition of the samples did not change.

The article discusses the results of research of the phase transition of the tetragonal phase into the monoclinic one near the fracture surfaces under the influence of shock compression of up to 36 and 52 GPa as well as initiated by other types of mechanical fracture of the sample.

Keywords: shock compression, partially stabilized zirconia, yttrium oxide, X-ray phase analysis, atomic force microscopy, scanning electron microscopy

Fig. 1. Microstructures of the initial PSZ powder (*а*) and the base surface of the sintered tablet (*б*) and the characterizing bar graphs: *а* – $\langle d \rangle$ = 71 nm, *б* – $\langle d \rangle$ = 422 nm

Fig. 2. Surfaces of breaks of the samples fractured by means of the bend (*а*) and mechanical impact fracture (*б*) and the characterizing bar graphs: *а* – $\langle d \rangle$ = 366 nm, *б* – $\langle d \rangle$ = = 387 nm

Fig. 3. Surfaces of the opened cracks of the samples recovered after shock-wave loading up to 36 GPa (*а*) and 52 GPa (*б*) and the characterizing bar graphs: *а* – $\langle d \rangle$ = 399 nm, *б* – $\langle d \rangle$ = 389 nm