Contribution ID: **1424** Type: **Poster**

Features of structure formation of Al2O3 ceramics doped with zirconium dioxide

Monday 30 October 2023 21:45 (15 minutes)

One of the most promising ways to obtain a dense ZTA material at relatively low sintering temperatures can be the use of metastable γ+θ-Al2O3 phases as a basis for composite ceramics. The work [1] shows the possibility of obtaining dense composite ceramics of the Al2O3 - YSZ system based on metastable powders γ + θ-Al2O3 at lower sintering temperatures compared to powders of the stable phase α-Al2O3, however, aggregation of the YSZ impurity in the intergranular space of Al2O3 leads to a decrease in the level physical and mechanical characteristics of ceramics due to the pronounced polydispersity of its structural elements. This problem can be solved by varying the conditions for obtaining composite ceramics, in particular, by varying the value of high hydrostatic pressure during the processing of compacts.

As a basis for ceramics, nanopowders of the γ + θ-Al2O3 + n% (ZrO2 + 3mol% Y2O3) (YSZ) system were used, where n = 0, 1, 5, 10, 15 wt.%, annealed in air at a temperature of 1000℃. The powder compacts were processed under high hydrostatic pressure (HHP) conditions ranging from 300 MPa to 700 MPa. The compacts were sintered in air at a temperature of 1550℃. The obtained ceramic composite had a two-phase structure α-Al2O3+n%YSZ.

The study of the surface structure by SEM showed the distribution of YSZ grains in ceramics depending on the treatment of compacts with HHP. At pressures of 300–500 MPa, YSZ grains are concentrated in the intergranular space of α-Al2O3, and at 600–700 MPa, YSZ grains are distributed over the entire volume of the ceramic matrix. In the first case, the structure of the ZTA composite corresponds to an aggregate-strengthened structure, and in the second case, to a dispersion-strengthened structure.

X-ray diffraction analysis and SEM revealed that the process of primary recrystallization and normal growth of α-Al2O3 grains occurs during sintering of compacts, which were processed under HHP conditions at 300-500 MPa. In compacts processed at 600-700 MPa, the process of secondary recrystallization occurs, which leads to a bimodal size distribution of α-Al2O3 grains.

The study of physical and mechanical characteristics showed that the maximum values of physical and mechanical characteristics are achieved in ceramic compositions Al2O3 + 10% YSZ (ρ = 4.1 g/cm3, Hv = 20.16 GPa, σ = 338 MPa) and Al2O3 + 15% YSZ (ρ = 4.09 g/cm3, Hv = 18.5 GPa, σ = 396 MPa) based on metastable θ + γ-Al2O3 powder annealed at 1000℃ and treated with high hydrostatic pressure at 700 MPa.

Primary author: МАЛЕЦКИЙ, Александр (ОИЯИ)

Presenter: МАЛЕЦКИЙ, Александр (ОИЯИ)

Session Classification: In-person poster session & welcome drinks

Track Classification: Condensed Matter Physics