Abstract

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Mechanical Properties and Plastic Deformation Mechanism of Alumina Nanocrystalline Ceramics

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Abstract

Excellent and superior properties of alumina (Al2O3) nanocrytalline ceramic make it a one of the highly demanded advanced ceramics in the present competitive scenario of manufacturing and industrial applications. α-Al2O3 nanoparticles with average particle size of 3.4, 5.2, 7.2 and 12.5 nm a series of Al2O3 nanocrystalline ceramic samples were prepared by grain size variation. (Two-step sintering). The inverse Hall Pitch relationship between the microhardness and grain size of Al2O3 nanocrystalline ceramic was observed. Critical grain size exists at which the properties of α- Al2O3 nanocrystalline ceramics change significantly. Indentation method was employed to test the fracture toughness of Al2O3 nanocrystalline ceramic. When the grain size decreased from 297 nm to 33 nm, the fracture toughness increased from 3.04±0.19 to 4.52±0.13 MPa·m1/2. The enhance of the diffusional creep rate and grain-boundary may be the causes of the improvement of fracture toughness. The maximum microhardness of α-Al2O3 Nanocrystalline ceramics (NCCs) with grain size is 22.32 GPa. Microstructure evaluation study of alumina Nanocrytalline ceramics is carried out by SEM, TEM and EDX. To study the microhardness and fracture toughness of alumnian nanocrytalline ceramics Vickers hardness test is performed. Further focusing on Investigate the behavior of positive and negative Hall pitch behavior by experimental and theoretical model results and evaluate the deformation mechanisms of alumina Nanocrystalline ceramics.

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