Compressive Deformation of Y_2O_3-Stabilized ZrO_2/Al_2O_3 Composite

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Compressive deformation of 80 wt% ZrO_2 (3 mol% Y_2O_3)/20 wt% Al_2O_3 composite was studied in air at temperatures from 1400° to 1550°C. Extraordinary large deformation (up to −1.8) was observed at strain rates from 10^{-3} to 10^{-4} s^{-1}. The stress exponent was from 1.2 to 2 and activation energy was 620±40 kJ/mol. It was observed that the Al_2O_3 aggregate evolved during the deformation. This phenomenon was explained by the grain rearrangement model as a consequence of grain switching doring the superplastic flow.

[*Received July 1, 1986*]

Preparation of Monodispersed Spherical $Ta_2O_5nH_2O$ Particles with Controlled Size*[1]

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Monodispersed spherical $Ta_2O_5nH_2O$ particles have been prepared by hydrolyzing $Ta(OEt)_5$ with water and basic catalyst in ethanol. The particle size was controlled within the range between 0.05 and 1 μm by adjusting the amount of water and catalyst. The results of change in particle size and of ζ potential measurement suggested that the particles grew by the coagulation mechanism. Particles were amorphous, transforming to crystalline Ta_2O_5 at 740°C without appreciable shape change.

[*Received February 1, 1986*]

Crack Configuration Beneath Vickers Indentation and Fracture Toughness Evaluation in Y_2O_3-Partially Stabilized Zirconia

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Crack configurations beneath Vickers indentation in 3 mol% Y_2O_3-partially stabilized zirconia ceramics with average grain sizes of 0.4 μm (Z3Y-I) and 1.0 μm (Z3Y-II) were examined and their fracture toughness was measured. Crack configurations were assessed by the dye penetrant technique and observations of the flaw distribution on the fracture surfaces by using scanning electron microscopy. The crack configurations of partially stabilized zirconia were found to be of Palmqvist type even at a high indentation load (50 kg). However, the Palmqvist type cracks were well-developed in the direction of indentation depth and appeared to be different in shape from the typical Palmqvist type cracks like those observed in WC-Co. Fracture toughnesses K_{IC} measured by the controlled surface flaw technique and the chevron notch technique were 7.13-7.26 MPa·m$^{1/2}$. K_{IC} values were also measured by the indentation fracture technique using Niihara et al. equation,

Lankford equation and Evans equation based on polynominal curve fitting. K_{IC} values obtained by using Niihara et al. equation were the lowest and those obtained by Lankford equation were the largest in three equations. The K_{IC}'s obtained by using Evans equation were intermediate between them, and 6.58 MPa·m$^{1/2}$ for Z3Y-I and 7.25 MPa·m$^{1/2}$ for Z3Y-II.
[Received January 18, 1986]

Tensile Strength of HP-Si_3N_4 at Room and Elevated Temperatures

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Tensile and three-point-bending tests were conducted at room and elevated temperatures on hot-pressed Si_3N_4 containing Y_2O_3 and Al_2O_3 to obtain information on characteristics of tensile strength and its relation to bending strength in ceramics. At room temperature, Weibull modulus in tensile tests was lower than that in bending ones. At 1200°C, strength decreased but Weibull moduli increased in both tests, and the increase in Weibull modulus of tensile tests was so remarkable that no significant difference was observed between tensile and bending tests. The tensile strength calculated from the results of bending tests using effective volume was lower than and almost equal to the observed value at room temperature and 1200°C respectively. Therefore, it is considered that the degree of dispersion of crack size in tensile specimens is different from that in bending ones at room temperature, and that the effect of crack size on the failure strength becomes less significant due to softening of the glassy phase at grain boundaries at 1200°C. Though the temperature dependence of tensile strength was similar to that of bending strength, it was difficult to obtain the precise failure stress by bending tests at 1400°C, because of plastical deformation.
[Received January 29, 1986]

Crystal Growth of α-Quartz from a Silica Gel Using Alkali Halide Flux

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Crystals of α-quartz were obtained from a silica gel in alkali halides. We found that the addition of LiCl to NaBr provides the most suitable flux. The gel was heated to 850°C, and cooled slowly near the transition temperature. By this treatment β-quartz was converted to α-quartz. The following results were obtained.

(1) The NaBr-LiCl system provides the best flux for the crystallization of α-quartz. The best flux molar ratio R_1 (= NaBr/LiCl) for obtaining α-quartz was 9.7/0.3.

(2) The crystal size decreased with decreasing ratio R_2 (= silica gel/flux, molar ratio) from 0.1 to 0.01, and reached a maximum (0.5×0.5×1.2 mm).

(3) When 1 wt%-$CaCO_3$ was added to the flux under conditions (1) and (2), an α-quartz crystal with a maximum size of 0.5×0.5×2.5 mm were obtained.
[Received February 10, 1986]