Sintering Behavior of Si_3N_4 with Y_2O_3 and Al_2O_3 Addition

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The densification behavior of Si_3N_4 with 5 wt% Y_2O_3 and 2 wt% Al_2O_3 was investigated using a dilatometer during heating for 1 h from 1750° to 1800°C in 1 atm N_2 (pressureless sintering) and from 1800° to 1980°C in 10 atm N_2 (gas pressure sintering). In the pressureless sintering, the densification occurred from 1600° to 1800°C. At 1800°C, the densification stopped after heating for 30 min due to the thermal decomposition of Si_3N_4. The maximum density of 71.7% theoretical was obtained in the pressureless sintering. In gas pressure sintering, the thermal decomposition was depressed and chemical reactions to increase the amount of liquid phase took place. The density of material was increased at 1800°-1980°C by a solution-reprecipitation process. The contribution of the process increased at higher sintering temperature. High density materials (relative density> 97%) were fabricated at 1930°-1980°C. The maximum density of 99.4% was obtained at 1950°C. Abnormal grain growth was observed during the densification at high temperatures which resulted in fibrous grains. [Received August 8, 1985]

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Joining of Silicon Nitride by Solder System La_2O_3-Y_2O_3-Al_2O_3

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Silicon nitride-to-silicon nitride joints were made by using pre-baked oxide pellet solder composed of La_2O_3·Y_2O_3·Al_2O_3·SiO_2 and BeO which were mixed, ground, and then made pellet form. Joining was carried out under a nitrogen pressure of 40-53 kPa at 1400°C to 1500°C by heating and cooling temperature rate from 50° to 1800°C/min to find out the optimum joining condition. From the result of microscopic examination, no void and crack were observed in the jointed layer. The results of EPMA in the cross-section of the jointed region indicated that some elements of adhesive (La, Y, Al) diffused into Si_3N_4 to form a diffusion layer, while a small amount of N was found in the joining layer. From the results of the three-point bending measurements, a joining strength of 290 MPa was obtained for the sample bonded at comparatively low temperature 1450°C. Distructed part is considered to start at the diffusion layer, indicating that the joining strength will be much higher than that value. The Vickers hardness of diffused layer was stronger than that of Si_3N_4 itself. [Received August 9, 1985]

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