Reduction of Dewaxing Time by Pressurized Atmosphere in the Ceramics Injection Molding Process

Makoto INOUE, Tadamoto SAKAI and Taro KATAGIRI*

Machinery and Electronics Technology Center, The Japan Steel Works, Ltd.
6-1, Minami 1-chome, Funakoshi, Aki-ku, Hiroshima-shi 736
* Tokai Konetsu Kogyo Co., Ltd.

The effects of the pressurized nitrogen atmosphere on the dewaxing time of injection molded Si_3N_4 green parts have been studied. As-molded parts of complex shapes, such as cutter blades and turbocharger rotors were used, and were dewaxed within one or two days at the heating rate of 10°-20°C/h in the pressurized (5 kg/cm²G) nitrogen gas atmosphere. On the other hand, dewaxing needed 6-20 days by the conventional method with the non-pressurized condition because of the limited heating rate of 1°-3°C/h. The extensive reduction in dewaxing time is explained in terms of the prevention of binder boiling and control of evolved gas volume.

[Received July 31, 1985]

pp. 78–80

Pressureless Sintering of Si_3N_4 with CeO_2, Y_2O_3 and Al_2O_3

Hisao SUZUKI and Hajime SAITO

Department of Mechanical Systems Engineering, Toyota Technological Institute
2-12-1, Hisakata, Tenpaku-ku, Nagoya-shi 468

Pressureless sintering of Si_3N_4 with CeO_2, Y_2O_3 and Al_2O_3 as sintering aids was carried out at 1750°C for 2 h in N_2 atmosphere. The amount of Al_2O_3 as an additive was 1.5 wt% and that of others (CeO_2 + Y_2O_3) was 15 wt%. The powder bed technique was used to suppress the decomposition of Si_3N_4. The addition of more than 7.5 wt% CeO_2 yielded Si_3N_4 materials having more than 95% relative density and flexural strengths of about 600 MPa at room temperature. These Si_3N_4 materials containing $Ce_5(SiO_4)_3N$, $Y_5(SiO_4)_3N$ and glassy phase as grain boundary phases were expected to have excellent high-temperature properties, such as superior oxidation resistance and high flexural strength at elevated temperature. With increasing the amount of CeO_2 addition, the fraction of α-Si_3N_4 solid solution, $\alpha'/(\alpha'+\beta)$, increased and reached about 65% for more than 10 wt% CeO_2 addition. The densification mechanism in this system was considered to be liquid phase sintering combined with reaction sintering in which α-Si_3N_4 solid solution was formed. With increasing temperature, α-Si_3N_4 solid solution transformed into β-Si_3N_4. The flexural strength of Si_3N_4 material containing 10 wt% of CeO_2 at 1300°C was as high as 500 MPa. The critical stress intensity factors (K_{IC}) of Si_3N_4 materials by the indentation microfracture method were about 6 $MN/m^{3/2}$.

[Received July 30, 1985]

pp. 81–9