CHAPTER 5

CONCLUSION

1. Si_3N_4 (Mixed powder B) was successfully sintered in air furnace. The bulk and relative densities after sintering at 1700 ^{O}C for 2 h were 3.18 g/cm^3, and 97.6 %, respectively. Small amount of mass loss, 1-2%, was observed. Moreover, two mass change phenomena, mass gain and mass loss, were observed. Mass gain was the result of oxidation.

$$Si_3N_4\ (s) + 3\ O_2\ (g) = 3\ SiO_2\ (l) + 2\ N_2\ (g)$$

In contrast, mass loss is presumed to be the reaction with Si_3N_4 and SiO_2.

$$Si_3N_4\ (s) + 3\ SiO_2\ (l) = 6\ SiO\ (g) + 2\ N_2\ (g)$$

2. Hardness and fracture toughness of the Si_3N_4 were 16 GPa and 5 MPa.m$^{(1/2)}$, respectively. These results are equivalent to TOSHIBA's commercial grade Si_3N_4.
3. As Si_3N_4 packing powders, SN-7, SN-7 added with BN, SN-E10, SN-KO5, and SN-F2 were tested. SN-E10 and coarse SN-F2 did not show serious agglomeration. However, SN-E10 is very expensive. Thus, SN-F2 is the candidate material for packing powder.
4. A-11 should be used as Al_2O_3 packing powder because A-11 showed weaker agglomeration than AM-21. AM-21 leaded to hard and strong agglomeration because of small particle size and large surface area.
5. Inside the small Al_2O_3 crucible, there was some reaction product. The reaction was supposed to be as follows.

$$12SiO_2\ (g) + 9Al_2O_3\ (s) + 4N_2\ (g) \quad = \quad Si_{12}Al_{18}O_{39}N_8\ (s)$$

Big Al_2O_3 crucible cracked after several times of usage.

6. The flexural strength of specimen from mixed powder B sintered at 1700 ^{O}C, 2 h measured by the method of ASTM F-394 was 420 MPa. This value is relatively low compared to ~ 600 MPa of commercial Si_3N_4.