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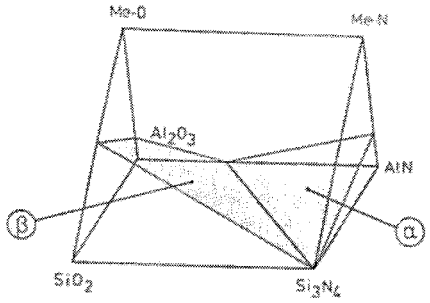
I. Introduction

Silicon nitride is one of the special ceramics at present being developed for gas turbines and other high-temperature engineering applications. A variety of ceramic materials based on β-Si_3N_4 and Si_2N_2O are being developed and recently attention has been focussed also on the solid solution ceramics of α-Si_3N_4 structure type, i.e. α'-sialon ceramics, which promise even better mechanical properties and thermal shock resistance as compared to the β'-sialon.



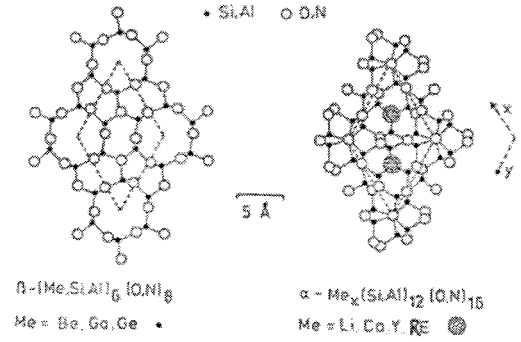


Fig. 1. The phase relations and crystal structures of α'-sialon and β'-sialon

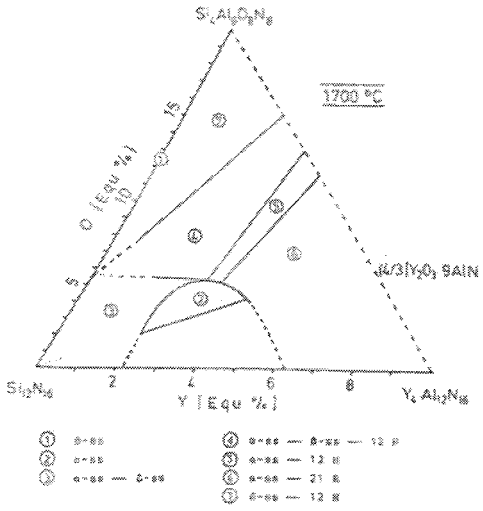


Fig. 2. Phase diagram in Si_3N_4-$Si_3Al_3O_3N_5$-$Y_4Al_2O_9$-$Y_4Al_{12}N_{16}$

II. The Crystal Chemistry of α'-sialons

The α'-sialon was reported to occur only in quinary Me-Si-Al-O-N system where Me=Li, Na, Mg, Ca, Mn, Y and a rare-earth metal except La and Ce. In contrast to the pure substitutional β'-sialon, α'-sialon has also an interstitial solubility for certain Me cations. In the α'-Si_3N_4 structure there are two interstitial holes per unit cell which can be occupied by cations (see Fig. 1).
So theoretically, it is possible that almost glass free nitrogen ceramics could be obtained by dissolution of a transient liquid phase into α-Si_3N_4 structure.

III. Gas pressure sintering of α'-sialon ceramics

At present work, Si_3N_4, AlN and Y_2O_3 powders have been used as raw materials to form α'-sialon with α-$Y_xSi_{12-(3x+y)}Al_{3x+y}O_yN_{16-y}$ (where $0.33 \leq x \leq 0.67$, $0.5 \leq y \leq 1.24$, $1.5 \leq 3x+y \leq 3$) accordance with the phase diagram (see Fig. 2).
By the gas-pressure sintering, the α'-sialon ceramics were densified, normally, the process would contain three steps (see Fig. 3), at first step, a partial of α'-sialon would form, otherwise no α'-sialon appeared any more at higher temperatures, second step is to close the open pores and at the third step, samples would be densified well under high gas pressures.

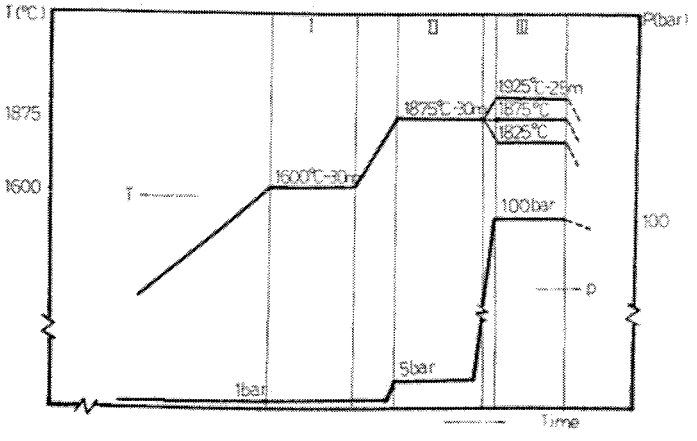


Fig. 3. Schematic diagram of the sintering process