below the deformation temperature of polycrystalline specimens, the crystals were composed of willemite, β-eucryptite, β-spodumene, cristobalite, quartz, and lithium mono- and di-silicates, having the size of $1\sim2\mu$ measured under microscope.

4) The bending strength of polycrystalline specimens changed in a high degree by composition. Although there seemd to exist no simple relation between the composition and the bending strength, the values of those of low alkali (Li_2O =4, 6, 8) and $Al_2O_3=0$ gave the exceptionally low values, which probably due to the existence of minute hair cracks came from the abnormal volume change at around 250°C of cristobalite formed in large amount in the specimens during the reheating.

5) The amount of Al_2O_3 produced a large effect on the thermal expansion of the specimens in the composition range given above. There was a trend that the expansion coefficient became smaller with the increase of Al_2O_3 content. Especially, high Al_2O_3 glasses containing small amount of Li_2O (=4 and 6) gave the products having exceedingly low expansion coefficient (5.4×10^{-7}). The specimens of $Al_2O_3=0$ have larger expansion coefficient. This may be interpreted by the formation of cristobalite having large expansion coefficent instead of β-eucriptite which lowers the expansion of devitrified products.

The Effects of Heat Treatment on the Strength of Polycrystalline Material Produced from the Glass of the System Li_2O-MgO-Al_2O_3-SiO_2

Sumio SAKKA, Masamichi WADA and Megumi TASHIRO

Yogyo Kyokaishi (*Journal of the Ceramic Association, Japan*), **69**, 35 (1961)

In the previous paper (*J. Ceram. Assoc. Japan*, 68 [10] 223 (1960)) the authors reported that some glasses of low lithium content (4%) in the system Li_2O-MgO-Al_2O_3-SiO_2 could be converted, by the heat treatment, into a polycrystalline material without showing any appreciable deformation even if no special nucleating agent, such as platinum, was added. The present paper contains the results of experiments designed to determine the optimum conditions of heat treatment of the glass of this type for producing a polycrystalline mateterial of high mechanical strength.

(1) **Chemical composition of the glass studied.** The glasses of the composition, MgO x, Al_2O_3 y, SiO_2 z, Li_2O 4, where $x+y+z=100$ by weight, were melted and formed into a specimen of the size $2.5\times5\times50$ mm. They were heated from room temperature to 1200°C with the rate of 5°C/min. and then held there for two hours. Among the polycrystalline materials, the one produced from a glass of the composition of Li_2O 4, MgO 15, Al_2O_3 23, SiO_2 62 showed the highest modulus of rupture (1,550 kg/cm^2).

(2) **Process of crystallization of the glass during heat treatmet.** Thermal differential and X-ray analysis made with the glass specimen of above composition

showed that, during its heat treatment, β-eucryptite was first precipitated at about 850°C and then β-spodumene at about 1000°C. Microscopic examination showed that β-spodumene, after its precipitation, decreased its grain size by fission, by still unknown reason, with increasing temperature. Above 1000°C the marked increase in specific density of the specimen with increasing temperature was also observed.

(3) **Effects of heat treatments on strength.** The conditions of heat treatment such as the heating rate and the maximum holding temperature were varied and their effects on the modulus of rupture of the resultant polycrystalline materials were determined. The slow heating with the rate at least below 5°C/min. in the temperature interval of 800 to 900°C, in which β-eucryptite was first precipitated in the specimen, was found to be necessary increasing the strength. The specimen which missed this heat treatment had poor strength. The strength was also found to increase with incresing the maximum holding temperature. This change was attributed to the decrease in grain size of β-spodumene and also to the compacting of microstructure.

Studies on the Dielectric Loss of Polycrystalline Material Produced from the Glass of the System Li_2O-MgO-Al_2O_3-SiO_2

Sumio SAKKA and Megumi TASHIRO

Yogyo Kyokaishi (*Journal of the Ceramic Association, Japan*), **69**, 393 (1961)

In the previous paper (*J. Ceram. Assoc. Japan*, **60** [10] 223 (1960)) the authors have given the method of converting the glasses of the system Li_2O-MgO-Al_2O_3-SiO_2 into a polycrystalline material with or without the addition of platinum nucleus, the amount of which was limited to a very small value. The results of the measurement of the mechanical and thermal properties of the material produced were also published (*J. Ceram. Assoc., Japan*, **69** [2] 35 (1961)). The present paper concerns the dielectric loss of the same material which was expected to show the effect of chemical composition and heat treatment.

(1) **Effect of heat treatment.** The glass of the composition, MgO 15, Al_2O_3 23, SiO_2 62, Li_2O x, where $x=4, 6, 8, 12$ by weight ratio, were melted, and reheated with the constant rate of 5°C/min. to a temperature from 750°C to 1200°C.

The tan δ at 1 Mc of the crystallized specimens showed that, in general, it became higher than the base glass by the heat treatment at a temperature between 750°C and 950°C, whereas the heating at a temperature higher than 1000°C brought about a great decrese in tan δ.

The increase of tan δ may be attributed to the formation of β-eucriptite which usually occurs in the low temperature range, while the sudden decrease in tan δ may be attributed to the formation of β-spodumen which appears with the cost of vanishing β-eucryptite.

(2) **Effect of the chemical composition of the base glass.** It is likely that