

천연베릴을 이용한 온도구배 환류법에 의한 합성 Emerald 단결정 육성

요업기술원 : 최의석, 김무경, 이종민.

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Single Crystal Growth of Synthetic Emerald by Reflux Method of Temperature Gradient used Natural Beryl

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ABSTRACTS

Emerald ($3\text{BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2 : \text{Cr}^{3+}$) single crystals were grown by reflux method of temperature gradient in the flux solution of $\text{Li}_2\text{O}-\text{MoO}_3-\text{V}_2\text{O}_5$ system. The composition of flux materials were 3 mole ratio of $\text{MoO}_3-\text{V}_2\text{O}_5/\text{Li}_2\text{O}$, substituted 0.2 mole % of K_2O , Na_2O , Nb_2O_5 etc to Li_2O content, solved 10-15% of beryl to flux quantity and doped 1% of Cr_2O_3 to emerald amount.

Thoes of mixing were melted at 1100°C in Pt containers of the 3 zone furnace of melt-growth-return to circulate continuously, specially it has been grown large emerald single crystal when thermal fluctuation was treated for 2 hrs of once time a day at $1050\sim 950^\circ\text{C}$ in growth zone, substitutional solid solution effect of Cr^{+3} ion for Al^{+3} to the growth of emerald single crystal was good. Emerald single crystals were $c(0001)$ hexagonal crystal face of preferential growth direction and $m(10\bar{1}0)$ post side. When it had been durated for 5 months emerald single crystals of the first size of 0.6mm thickness of seed crystal were grown $32 \times 65\text{mm}(c \times m)$ of maximum size and 6.2mm thickness.

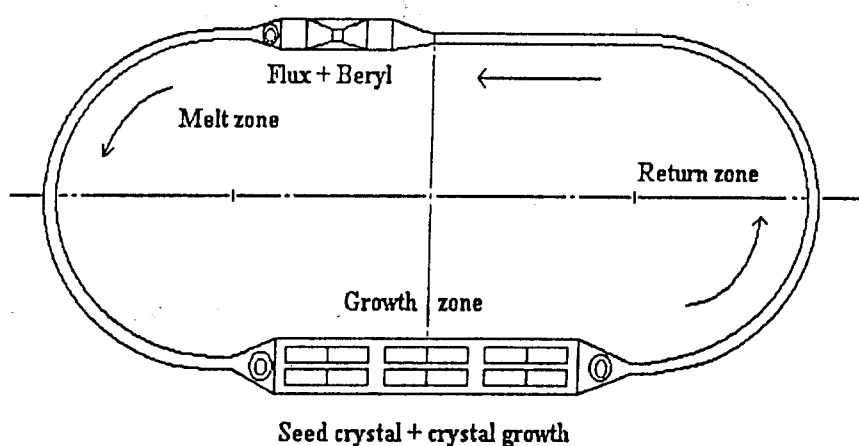


Fig. 1. Crystal growth apparatus of circulation to flux and beryl melt of temperature gradient in 3zone furnace.

Table 1. Flux Composition and Temperature Gradient

condition testing code	flux(V-M/L=3) constitution (mol %)	temperature gradient °C		
		M	G	R
NK	Na ₂ O+K ₂ O 0.2	1050	950	1020
Nb	Nb ₂ O ₅ 0.2	1050	950	1020
NK-Nb	Na ₂ O+K ₂ O 0.2 Nb ₂ O ₅ 0.2	1030	930	990

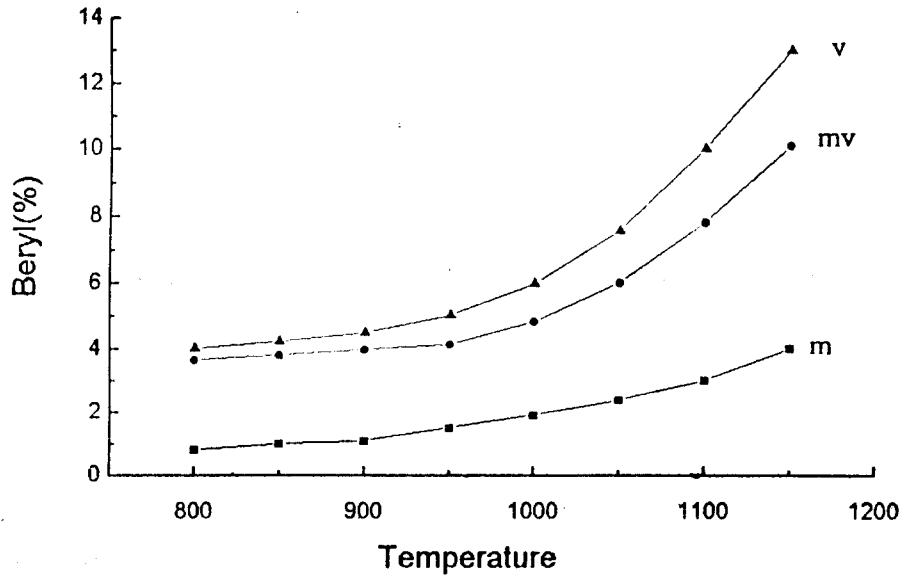
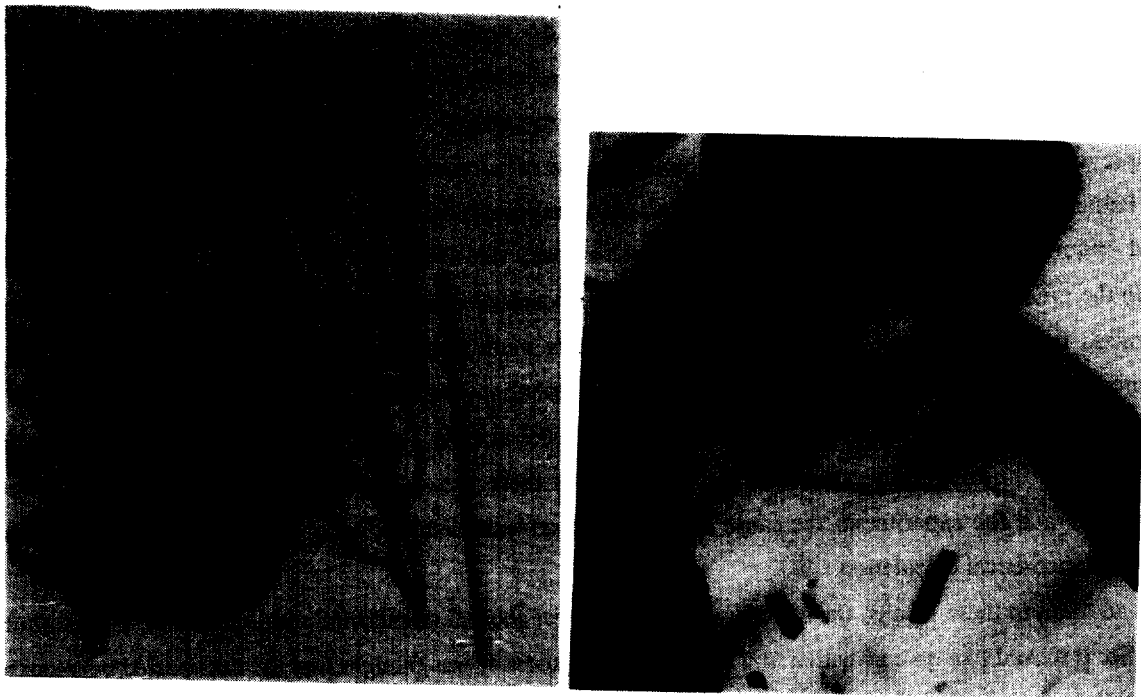


Fig. 2. Solubility curves of natural beryl in $\text{MoO}_3\text{-V}_2\text{O}_5/\text{Li}_2\text{O}$ flux. (m: $\text{NoO}_3\text{-V}_2\text{O}_5/\text{Li}_2\text{O}$, v: $\text{V}_2\text{O}_5/(\text{Na}, \text{K})_2\text{O}$, mv: m+vflux)



a)

b)

Fig. 3. Growth crystal of emerald.

a : grown crystal (m, c face) b : inclusion of cluster.