## 15-Crystal Growth



**PS-15.02.02** MASS TRANSPORT EFFECT WITHIN THE SOLID-LIQUID INTERFACE BOUNDARY LAYERS IN SOLUTION CRYSTAL GROWTH. By Yu Xiling*, Liu Youchen and Yue Xuefeng, Institute of Crystal Materials, Shandong University, Jinan 2510100, P.R. China

In kinetics theories of high temperature solution growth, it is considered that the mass transport within the solid-liquid interface boundary layer is a diffusion process only, and that the concentration gradient distribution in this layer is homogeneous. There is, however, a lack of experimental evidence of this fact.

Using holographic phase-contrast interferometric microphotography, we have carried out real-time recording of the dynamic processes which take place during the crystal growth of KTP from high-temperature solutions and of KDP from low-temperature solutions. The relation between the boundary layer thickness at different places on the same crystal face and the depth of the crystal soaked in the solution, the relation between the boundary layer thickness and supersaturation, the concentration distribution and the refractive index gradient distribution within the boundary layers have all been investigated in detail. The experiments demonstrate that the mass transport process within the solid-liquid interface boundary layers is the result of the coupled effects of diffusion and convection, no matter whether it is high-temperature or low-temperature solution growth. The distribution of the concentration gradient in the layers are exponential functions of the position under the free convection state.

**PS-15.02.03** INVESTIGATION ON GROWTH AND SOME PROPERTIES OF POTASSIUM TANTALATE CRYSTALS. By Meng Xianlin*, Sun Youxuan, Zhu Li, Wang Ruihua, Wei Jingqian, Wang Jiyang and Lu Yaogang. Institute of Crystal Materials, Shandong University, Jinan 250100, China.

Potassium tantalate ($KTaO_3$, KT) single crystals with a stable cubic structure have a wide range of applications in LASER beam modulators, digital light deflectors and semiconducting devices. These crystals are also a promising substrate material because they exhibit no phase transition in a temperature range from 0° K to the melting point and have good lattice matching. Previously, KT crystals have been grown either by the slow-cooling method (D. Rytz, *J. Cryst. Growth*, **59**, 1982, 468), or a variation of the Kyropoulos Technique (W.A. Bonner *et al.*, *Am. Ceram. Soc. Bull.*, **44**, 1965, 9) but the crystal growth rate was very slow (0.03 to 0.14 mm/h). In our present wotk, high quality KT single crystals ($36*35*16$ mm$^3$ in size and 128 g in weight) have been grown by using the Czochralski technique and the growth rate is 10 times faster than that in the above mentioned two methods. The transmission spectrum of as-grown KT crystals was determined and the result indicates that the crystal is transparent in the band range from 0.4 to 2.6 μm. The morphology of the crystals were studied. It is observed that the growth morphology is mainly defined by {100} and {110} faces. The lattice parameter, $a$, and the density of the crystal, ρ, were determined: $a$ = 3.988 Å, ρ = $7.020 * 10^3$ Kgm$^{-3}$. The value of the density of KT crystals grown by the Czochralski technique is the closest to the theoretical value ($7.018 * 10^3$ Kgm$^{-3}$). This indicates that the crystals grown by the Czochralski technique have a better crystalline perfection than those grown by other methods. The dielectric constant, ε, of KT has been measured. We have found that, at lower temperatures (- 200 to 0°C), ε decreases rapidly with increasing temperature, whereas the rate of decrease becomes slower at higher temperatures (0 to 400 °C).

**PS-15.02.04** CRYSTAL MORPHOLOGY OF YIG GROWN IN HIGH TEMPERATURE SOLUTIONS. H. M. Park, K. I. Seo and S. J. Chung*, Department of Inorganic Materials Engineering, College of Engineering, Seoul National University, San 56-1, Shinlim-Dong, Kwanak-Gu, Seoul, 151-742, Korea

Single crystals of YIG were grown in high temperature solutions of various contents of $BaO-xB_2O_3-(0.62-x)BaF_2$ ($0.21 \le x \le 0.62$) by top seeded solution growth. To investigate the effects of growth conditions on the anisotropic growth rate, slow cooling method as well as temperature gradient method were used and the viscosities of high temperature solutions were measured. By the slow cooling method, the solutions were slowly cooled at various cooling rates. By the temperature gradient method, nutrient of stoichiometric YIG composition was added to the solution at different constant temperatures. The grown crystals were up to 2.5 cm in size, and the crystal morphology was a combination of {211} and {220}. The relative development of the two faces depends on the growth rate in the direction perpendicular to each face. The relative growth rate can be calculated from the ratio of widths of the two faces. In the solution of increased $BaF_2$ contents and higher viscosity at higher temperatures or slower cooling rate, face {220} is dominantly developed, while in reversed conditions face {211} is dorminant. The morphology of grown crystal can be easily estimated if the growth temperature, cooling rate and the solution composition are known. X-ray topographic investigation and TEM observation on the grown crystals were carried out.

**PS-15.02.05** CRYSTAL GROWTH OF $NdAl_3(BO_3)_4$ IN HIGH TEMPERATURE SOLUTIONS AND MORPHOLOGICAL INVESTIGATIONS. By S. T. Jung*, D. Y. Choi, S. J. Chung, Department of Inorganic Materials Engineering, Seoul National University, Seoul, 151-742, Korea.

$NdAl_3(BO_3)_4$ single crystals were grown from high temperature solutions by slow cooling method and top seeded solution growth technique. Fluorides such as $BaF_2$ or KF were gradually added to the flux of $BaO-B_2O_3$ or modified $K_2O-MoO_3$ respectively. As the amount of fluoride increased, increase of growth velocity, change of morphology, and contraction of the primary crystallization region in phase diagram were observed. When using modified $K_2O-MoO_3$ flux and the molar ratio of $KF/K_2O$ was over 0.7, NAB rarely formed. The crystals grown using 50 cc Pt crucible were up to 10x10x20 mm$^3$ in size.

The lattice parameters and space group of grown crystal confirmed those already reported(E.L. Belokoneva and T.I. Timchenko, Sov. Phys. Crystallogr., 1983, 28(6), 658-661) by X-ray diffraction. The space group is C2/c. The results of energy dispersive X-ray analysis showed that Ba ion was not included in the crystals grown from

  