

## **A promising new piezoelectric material - Langasite and its related compounds -**

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### **Abstract**

Recent progress of electric technology requires new piezoelectric crystals having superior properties such as zero temperature coefficients and large electromechanical coupling factors. We have developed a series of new leading candidates,  $\text{La}_3\text{Ga}_5\text{SiO}_{14}$  (langasite, LGS),  $\text{La}_3\text{Nb}_{0.5}\text{Ga}_{5.5}\text{O}_{14}$  (LNG),  $\text{La}_3\text{Ta}_{0.5}\text{Ga}_{5.5}\text{O}_{14}$  (LTG), to satisfy those requirements. High quality LGS, LNG and LTG single crystals, with dimensions of 2 inches in diameter, were successfully grown by the Czochralski method at a pulling rate of 1mm/h. Since no variation of chemical composition was observed when whole melt in a crucible was crystallized, congruency of these compositions was confirmed. Physical constants such as elastic constants, dielectric constants and piezoelectric constants were measured. Filters and oscillators made of grown LGS, LNG and LTG single crystals showed superior properties such as three times wider passband than that of quartz, low insertion loss and easy processing. Langasite family crystals were shown to be superior materials to other known materials such as quartz,  $\text{LiTaO}_3$ ,  $\alpha\text{-AlPO}_4$  and  $\text{Li}_2\text{B}_4\text{O}_7$ .