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Piezoelectric Applications

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Czochralski Growth of 2 Inch $\text{Ca}_3\text{Ta}(\text{Ga},\text{Al})_3\text{Si}_2\text{O}_{14}$ Single Crystals for Piezoelectric Applications

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ABSTRACT

Growth of 2-inch diameter Al-substituted $\text{Ca}_3\text{TaGa}_3\text{Si}_2\text{O}_{14}$ crystals by Czochralski method is reported. The crystals were grown from the melt of $\text{Ca}_3\text{TaGa}_{1.5}\text{Al}_{1.5}\text{Si}_2\text{O}_{14}$ composition and had langasite structure. No inclusions of secondary phases were detected in these crystals. The $\text{Ca}_3\text{Ta}(\text{Ga},\text{Al})_3\text{Si}_2\text{O}_{14}$ mixed crystals produced using non-substituted $\text{Ca}_3\text{TaGa}_3\text{Si}_2\text{O}_{14}$ seeds were defective. They had cracks and/or poly-crystalline structure. However, those grown on the seed of approximately $\text{Ca}_3\text{TaGa}_{1.5}\text{Al}_{1.5}\text{Si}_2\text{O}_{14}$ composition were defect-free. Phase diagram of the $\text{Ca}_3\text{TaGa}_3\text{Si}_2\text{O}_{14}$ - $\text{Ca}_3\text{TaAl}_3\text{Si}_2\text{O}_{14}$ pseudo-binary system and segregation phenomenon are discussed in some details. Homogeneity of the crystals was evaluated by measuring 2D-mapping of leaky surface acoustic wave (LSAW) velocities for Y-cut $\text{Ca}_3\text{TaGa}_{1.5}\text{Al}_{1.5}\text{Si}_2\text{O}_{14}$ substrate. Although some inhomogeneities were observed due to slight variations in chemical composition, the crystal had acceptable homogeneity for applications in acoustic wave devices exhibiting the LSAW velocity variation within $\pm 0.048\%$.

Keywords:

A1. Solid solutions, A2. Czochralski method,
A2. Growth from melt, B2. Piezoelectric materials,

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