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Czochralski Growth of 2 Inch $Ca_3Ta(Ga,Al)_3Si_2O_{14}$ Single Crystals for Piezoelectric Applications

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ABSTRACT

Growth of 2-inch diameter Al-substituted $Ca_3TaGa_3Si_2O_{14}$ crystals by Czochralski method is reported. The crystals were grown from the melt of $Ca_3TaGa_{1.5}Al_{1.5}Si_2O_{14}$ composition and had langasite structure. No inclusions of secondary phases were detected in these crystals. The $Ca_3Ta(Ga,Al)_3Si_2O_{14}$ mixed crystals produced using non-substituted $Ca_3TaGa_3Si_2O_{14}$ seeds were defective. They had cracks and/or poly-crystalline structure. However, those grown on the seed of approximately $Ca_3TaGa_{1.5}Al_{1.5}Si_2O_{14}$ composition were defect-free. Phase diagram of the $Ca_3TaGa_3Si_2O_{14}$ - $Ca_3TaAl_3Si_2O_{14}$ 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 $Ca_3TaGa_{1.5}Al_{1.5}Si_2O_{14}$ 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 ±0.048%.

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