Langasite Crystals: Growth, Composition and Physical Properties

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Single crystals with melt composition $La_3Ga_5SiO_{14}$ (growth atmosphere – Ar) (I) and $La_3Ga_5SiO_{14}$ (II), $La_3Ga_{5.14}Si_{0.86}O_{14}$ (III), $La_3Ga_5Si_{0.9}Ge_{0.1}O_{14}$ (IV) (growth atmosphere 99÷98%Ar+1÷2% O_2) are grown by the Czochralski method in the <0001> direction. It was found that growth conditions change structural parameters, type and concentration of point defects and also physical properties in the volume of crystals.

For all crystals in the temperature range from 20 to 600 ^oC the level of activation is E=0.94 (±0.02) eV. Specific resistance of crystals at 350 ^oC changes depending on the initial composition of melt and growth conditions: from $4.6 \cdot 10^6$ Ohm·cm (crystal I) to $1.26 \cdot 10^7$ Ohm·cm (crystals II-IV). Anisotropy of tangent of dielectric losses angle was found: in the <0001> direction the value of temperature maximum of relaxational losses is shifted by 20 ^{o} into the high temperature area compared to direction <11-20>. This is connected with the influence of structural defects having polarization in electric field (for example: inclusions, vacancies etc). Treatment of crystals at 1000 ^oC in vacuum leads to decreasing oxygen vacancies what is accompanied by shifting of temperature maximum of dielectric losses from 310 ^oC to 430 ^oC.

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