MECHANICAL PROPERTIES AND LATTICE PARAMETERS OF $Lu_{2x}Gd_{2(1-x)}SiO_5$:Ce SCINTILLATION CRYSTALS

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Rare earth orthosilicates are well known scintillators used in medical diagnostics, high-energy physics, well logging. Perfect cleavage planes in some of them, for example, in Gd_2SiO_5 (GSO) [1], hamper mechanical processing of ingots and decrease yield of crystal elements.

Structure characteristics of $Lu_{2x}Gd_{2(1-x)}SiO_5$:Ce complex oxides with different Lu/Gd ratio obtained by Czochralski method have been determined in the present work. Two distinct monoclinic symmetry groups (*C2/c*, *Z*=8 and $P2_1/c$, *Z*=4) are formed in LGSO crystals in dependence on Lu/Gd ratio, that is, effective radius of rare-earth cation. Brittleness of crystals with $P2_1/c$ structure increases at addition of 2 – 15 % Lu into the GSO matrix. In addition, these crystals contain big quantity of inclusions, possess low light yield and bad energy resolution [2]. Crystals with C2/c symmetry forming at Lu content more than 20 % possess good plasticity, analogically to Lu_2SiO_5 (LSO) crystals. Elementary cell volume in the LSO matrix increases by more than 5 % at substitution of 80 % of smaller Lu^{3+} (ionic radius 0.086 nm) by larger Gd^{3+} ions (0.094 nm) indicating large isomorphic capacity of *C2/c* structure. This substitution does not worsen mechanical properties significantly and improves segregation of activator (cerium) into the matrix. However, the spread in microhardness values exceeds 1.5 times at lutetium content more than 35 % indicating that Lu/Gd ratio may be not stable along the ingots.

Thus, crystals with symmetry group *C2/c* and Gd content up to 60 – 70 % possess good plasticity and high values of microhardness. Combination of good mechanical properties and scintillation characteristics [2], lower cost of fabrication in comparison with LSO makes these crystals attractive for practical applications.

References

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