CZOCHRALSKI GROWTH AND SCINTILLATION PROPERTIES OF BULK GADOLINIUM PYROSILICATE ($Gd_2Si_2O_7$:Ce) CRYSTALS

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Crystals of rare-earth pyrosilicates ($Ln_2Si_2O_7$) are considered as promising scintillation materials for medical diagnostics and well logging. Recently, single crystals of lutetium pyrosilicate $Lu_2Si_2O_7$:Ce have been obtained with improved scintillation properties in comparison with oxyorthosilicates (GSO, LSO, etc.) [1].

Obtaining of lanthanide pyrosilicates $1Ln_2O_3{:}2SiO_2$ with bigger ionic radii is complicated in compare LPS, because such compounds can not be obtained by direct crystallization from melt. Analysis of phase transitions shows that compounds of lanthanides with ionic radius more than 0.87 Å (Er, Tm, Yb, Lu) do not melt congruently [2]. However, it was shown [3] that $Gd_2Si_2O_7$:Ce single crystals may be obtained at doping with big quantity of cerium (2.5 – 25 mol. %) leading to changes in Gd_2O_3 – SiO_2 phase diagram. It was shown that GPS:Ce crystals obtained by FZ method are very promising for monitoring of γ-radiation and thermal neutrons [4].

In the present work, bulk single crystals of gadolinium pyrosilicate doped with 10 % Ce have been obtained by for the first time by the Czochralski method using inductive heating furnace. After series of experiments, a GPS:Ce crystal with weight 60g and diameter 30 mm have been grown. Elements with dimensions 10x10x2 and 10x10x0.5 mm were cut for measurements of scintillation characteristics. Light yield under γ-irradiation (^{137}Cs) is about 400 % in comparison with BGO, and light yield under thermal neutrons is about twice higher in comparison with GSO. Thermal stability of GPS:Ce light yield and thermal stimulated luminescence were also studied.

Works on choice of optimal melt composition, as well as optimization of thermal field in crystallizer aimed at obtaining single crystals of high optical quality are under way.

References

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