Materials Based on Oxide Compounds for Composite Scintillators

Ia. Gerasymov, T. Nepokupnaya, A. Boyarintsev, O. Sidletskiy, D. Kurtsev, O. Voloshyna, Yu. Onufriyev, T. Grynko, O. Trubaeva, V. Pedash

Institute for Scintillation Materials of National Academy of Sciences of Ukraine, 60 Nauky Ave., 61001 Kharkov, Ukraine

Single crystals, optical ceramics, Cherenkov glasses, plastic scintillators are commonly used as sensitive elements of scintillation detectors. These scintillation materials have both undeniable advantages and a number of disadvantages and application limitations. The main disadvantage of bulk single crystals of a good optical quality is a complex and expensive technology for their production. Using of composite scintillators manufactured from fine granules distributed in a binder medium [1] enables to avoid the stage of bulk single crystal growth. The granules can be obtained by solid-state synthesis, by crushing of solidified melts, or by sol-gel method. Another advantage of composite scintillators is the possibility of detectors production on their basis of any size and shape.

This work is focused at search for optimal process to produce composite scintillation detectors manufactured on the base of Y_2SiO_5:Ce (YSO:Ce) and $Gd_3(Al_xGa_{1-x})_5O_{12}$:Ce (GAGG:Ce) scintillators. YSO:Ce is a standard oxide scintillator used in various types of scintillation detectors, including HEP experiments. GAGG:Ce is a new promising material which outperforms all known oxide single crystals by the light yield.

In this study YSO:Ce and GAGG:Ce materials were obtained in the form of powders synthesized by solid-state method, fragments after crushing of single crystal, as well as in the form of fragments after solidified melt crushing. Composite scintillators on their basis were manufactured using radiation-resistant polysiloxane elastomer as a binder medium [2]. Luminescent and scintillation properties of the obtained composite samples were studied and compared with those of standard bulk YSO:Ce and GAGG:Ce single crystals. The scintillation and luminescence characteristics of the composite scintillators and single crystals are similar. It was shown that composite scintillators are promising for application in HEP calorimeters and medical X-ray sensitive screens.

[1] Nikolai Z. Galunov, Boris V. Grinyov, Natalya L. Karavaeva, Yaroslav V. Gerasymov, Oleg Ts. Sidletskiy, and Oleg A. Tarasenko, Gd-Bearing Composite Scintillators as the New Thermal Neutron Detectors, *IEEE Transactions on Nuclear Science* **58**(1) (2011) 339-346.

[2] A.Yu. Boiaryntsev, N.Z. Galunov, N.L. Karavaeva, A.V. Krech, I.V. Lazarev, L.G. Levchuk, T.A. Nepokupnaya, V.D. Panikarskaya, V.F. Popov, P.V. Sorokin, O.A. Tarasenko, Study of radiation-resistant gel bases for composite detectors, *Functional Materials* **20**(4) (2013) 471-476.