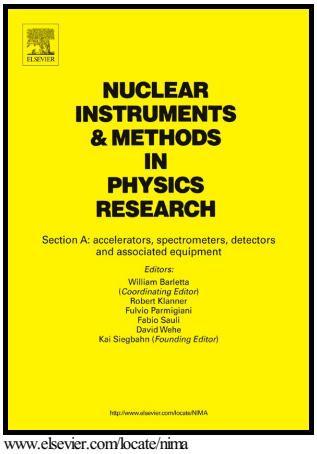

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ABSTRACT

The luminescence and scintillation properties of $Gd_{1.53}La_{0.47}Si_2O_7$:Ce (GPSLa23.5%:Ce) scintillators were investigated and compared to those of $Lu_{1.9}Y_{0.1}SiO_5$:Ce (LYSO:Ce) scintillators. At 662 keV γ-rays, the light yield of 33,500 ± 3,300 ph/MeV obtained for GPSLa23.5%:Ce is higher than that of 28,100 ± 2,800 ph/MeV obtained for LYSO:Ce. The energy resolution of 4.8 ± 0.2 % obtained for GPSLa23.5%:Ce is much better than that of 8.2 ± 0.3 % obtained for LYSO:Ce due to its better intrinsic resolution and proportionality of light yield. The light yield and energy resolution for α- rays, as well as a light yield ratio under excitation with α - and γ - rays (α/γ ratio) were also determined. The intrinsic light yield and light loss coefficient under excitation with 662 keV γ-rays were evaluated. The total attenuation coefficient at 60 keV and 662 keV γ - rays was also determined and compared with the theoretical one calculated using the WinXCom program.

Keywords: Energy resolution; Light yield; Luminescence; Scintillation; GPSLa23.5%:Ce ; $Lu_{1.9}Y_{0.1}SiO_5$:Ce

1. Introduction

Ce^{3+}-doped lutetium oxyorthosilicates Lu_2SiO_5 (LSO:Ce) [1] and $(Lu,Y)_2SiO_5$ (LYSO:Ce) [2] are well-known scintillators applied for positron emission tomography (PET) due to their desirable properties such as high density, high light yield and fast scintillation decay. Optical studies of Ce^{3+}-doped oxyorthosilicate crystals showed two Ce^{3+} emission bands related to two different Ce^{3+} crystallographic sites [3,4]. A considerable drawback of these materials is a fairly strong afterglow at room temperature (RT) related to the presence of a thermally stimulated luminescence (TSL) peak around 340 K [5]. Annealing experiments in reducing or oxidizing atmospheres led to the suggestion that the corresponding trap(s) could be related to oxygen vacancies [6]. Ce^{3+}-doped lutetium pyrosilicate $Lu_2Si_2O_7$:Ce (LPS:Ce) was also found as a good inorganic scintillator [7]. Electron paramagnetic resonance (EPR) study of LPS:Ce showed that the Ce ion substitutes for the only Lu crystallographic site in the LPS structure, while in the LSO structure it substitutes for both available Lu crystallographic sites [8]. The light yield and scintillation decay time of LPS:Ce are comparable to