Scintillation properties of LYSO single crystals activated with Cerium and Molybdenum

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In the last two decades, great R&D effort brought several new material systems, namely the Ce-doped orthosilicates as Gd2SiO5 (GSO), Lu2SiO5 (LSO), (Lu1−xYx)2SiO5 (LYSO), pyrosilicates based on RE2Si2O7 (RE=Lu, Y, Gd) and most recently LaX3 (X=Cl,Br) single crystal hosts. Ce:LSO and Ce:LYSO single crystals co-doped with Ca2+ have been recently investigated and improvement in their scintillation characteristics were claimed [1,2] which is based on the suppression of slow delayed recombination processes. Positive role of stable Ce4+ centers has been proposed in [2] to explain the improved scintillation performance. Also, Mo co-doping with Pr3+ [3-5] and Ce3+ [6] in the several host materials such as YAlO3 (YAP), LuAlO3 (LuAP), Lu1.3Al1.7O3 (LuYAP), and Lu3Al5O12 (LuAG) were investigated. Those studies showed that the co-doping of Mo is capable of improving the scintillation properties. However, there was no report about the Mo co-doping with Ce for LYSO host.

In this study, we investigated Mo co-doping effects on luminescence and scintillation properties of Ce:LYSO single crystal scintillators. The Mo co-doped Ce:LYSO single crystals were prepared by micro-pulling down (μ-PD) method with a wide concentration range of the co-dopants. Absorption, radioluminescence, PLE and PL spectra were measured together with several other scintillation characteristics, namely the scintillation decay and light yield to reveal the effect of Mo co-doping. Comparing to Ce3+ only doped LYSO, Mo 1000 ppm co-doped crystal has almost 1.5 times higher light yield and shows slightly accelerated scintillation decays. Details of changes in scintillation properties with Mo co-doping will be discussed.

References


Fig. 1. Energy spectra of 662 keV γ-rays from a 137Cs source measured with Mo co-doped and non co-doped Ce:LYSO crystals