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 Gd_2SiO_5 (GSO), Lu_2SiO_5 (LSO), $(Lu_{1-x}Y_x)_2SiO_5$ (LYSO), pyrosilicates based on $RE_2Si_2O_7$ (RE=Lu, Y, Gd) and most recently LaX_3 (X=Cl,Br) single crystal hosts. Ce:LSO and Ce:LYSO single crystals co-doped with Ca^{2+} 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 Ce^{4+} centers has been proposed in [2] to explain the improved scintillation performance. Also, Mo co-doping with Pr^{3+} [3-5] and Ce^{3+} [6] in the several host materials such as $YAlO_3$ (YAP), $LuAlO_3$ (LuAP), $Lu_xY_{1-x}AlO_3$ (LuYAP), and $Lu_3Al_5O_{12}$ (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 Ce^{3+} 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

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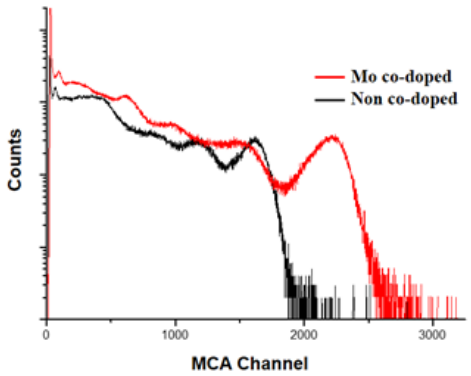

Fig. 1. Energy spectra of 662 keV γ-rays from a ^{137}Cs source measured with Mo co-doped and non co-doped Ce:LYSO crystals