# Effect of Mo co-doping on scintillation properties of Ce:$Gd_3(Ga, Al)_5O_{12}$ single crystal scintillators with various Al-to-Ga ratios

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The Cerium doped Gadolinium Aluminum Gallium Garnet (Ce:$Gd_3(Ga,Al)_5O_{12}$, Ce:GAGG) presented by Kamada et al. [1] is the most attractive scintillator material from the point of view of light output, decay time, energy resolution, density and absence of intrinsic radioactivity [2]. Many studies have been continued on the effects of rare earth doping and/or co-doping with various cations in GAGG crystal structure, multicomponent garnet based on $Y_3Al_5O_{12}$ (YAG) crystal with an admixture of Ga and Gd, to improve its properties. It was reported that the scintillation properties of Ce:GAGG are dependent on the ratio of Ga to Al [3,4].

In this study, the performance of Mo co-doped Ce0.5%:$Gd_3Ga_xAl_{5-x}O_{12}$ single crystal scintillators with different ratio of Al and Ga (x=2.4, 2.7, 3.0) was investigated. All these crystals were prepared by the micro-pulling down (μ-PD) method with a wide concentration range of the Mo co-dopant. We have investigated the relationship between the effect of reducing Ga content in Ce:GAGG and the effect of co-doping with Mo ion in Ce:GAGG. The scintillation properties of the grown crystals such as light yield and scintillation decay time and non-proportionality in scintillation response were evaluated. Light output was increased in a sample with the small amount of Mo concentration and maximum light output of 112% compared to the non co-doped Ce:GAGG was obtained in the Mo 300 ppm co-doped crystal with x=3.0. The scintillation decay was also accelerated to 57.2 ns by Mo 500 ppm co-doping with x=3.0. The Mo co-doped crystals with x=3.0 showed a higher light yield and faster decay time than those with x=2.4 and 2.7.

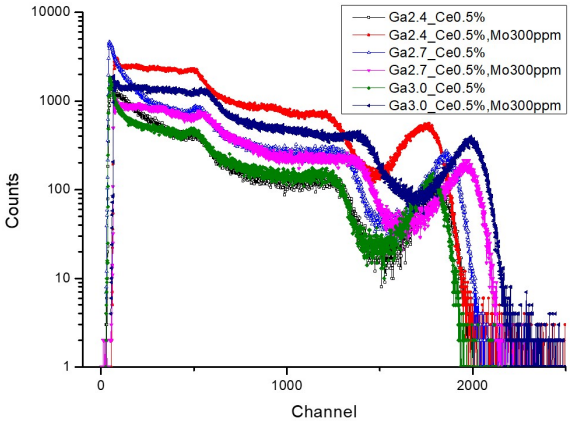


Fig. 1. Energy spectra of 662 keV γ-rays from a $^{137}Cs$ source measured with Mo co-doped and non co-doped Ce:GAGG crystals with different ratio of Al and Ga.

## References

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