

Ho³⁺ Codoping of GGAG:Ce: A Detailed Analysis of Acceleration of Scintillation Response and Scintillation Efficiency Loss

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SUPPLEMENTARY INFORMATION

XRD analysis revealed that GGAG:Ce codoped with 6.21 at.% of Ho³⁺ contains two garnet phases, see Figure S1. The secondary phase copies the XRD pattern of the primary one, however, the peaks are shifted towards lower angles. These results suggest that both phases are structurally similar, but the secondary phase has larger unit cells. The amount of the secondary phase is estimated up to 5 wt%. Any additional phase was not found in other samples, see Figure S2 with XRD spectrum of the non-codoped GGAG:Ce.

The secondary phase island in GGAG:Ce codoped with 6.21 at.% of Ho³⁺ was localized using back-scattered electrons (BSE) imaging, see Figure S3, and further analyzed with EPMA. The results showed the content of Ho³⁺ in secondary phase was reduced to one third when compared to the primary phase in favor of Gd³⁺. This is in line with the observations from XRD, as garnet structure with higher amount of Ho³⁺ are expected to have smaller unit cell as the lattice parameter for Gd₃Al₅O₁₂ is 12.21 Å while that of Ho₃Al₅O₁₂ is 12.08 Å (1).

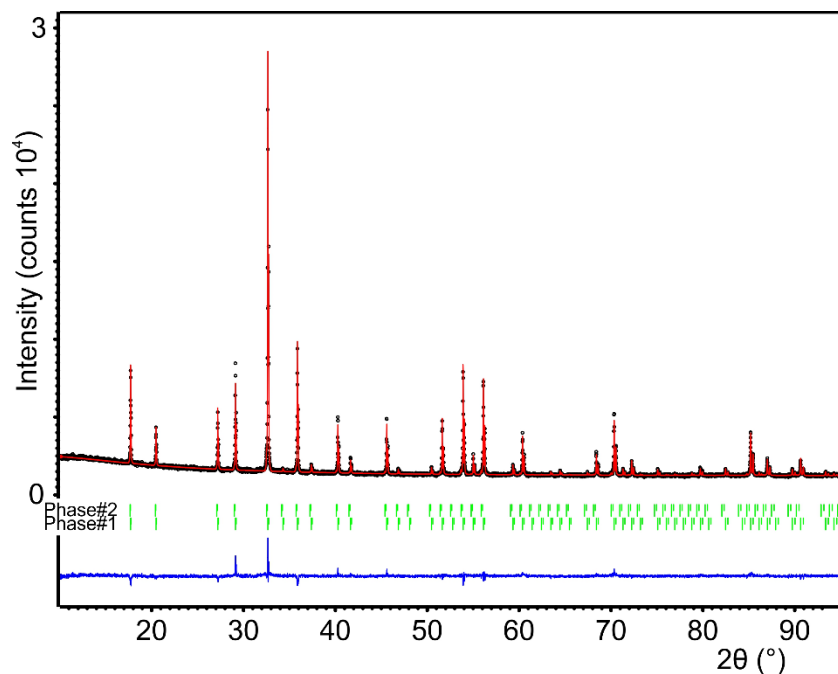


Figure S1: Result of Rietveld refinement of GGAG:Ce codoped with 6.21 at.% of Ho³⁺. The black points represent the measured pattern, the red line corresponds to the calculated pattern, the blue curve is the difference between the measured and calculated data, and the green bars show the Bragg positions of both phases.

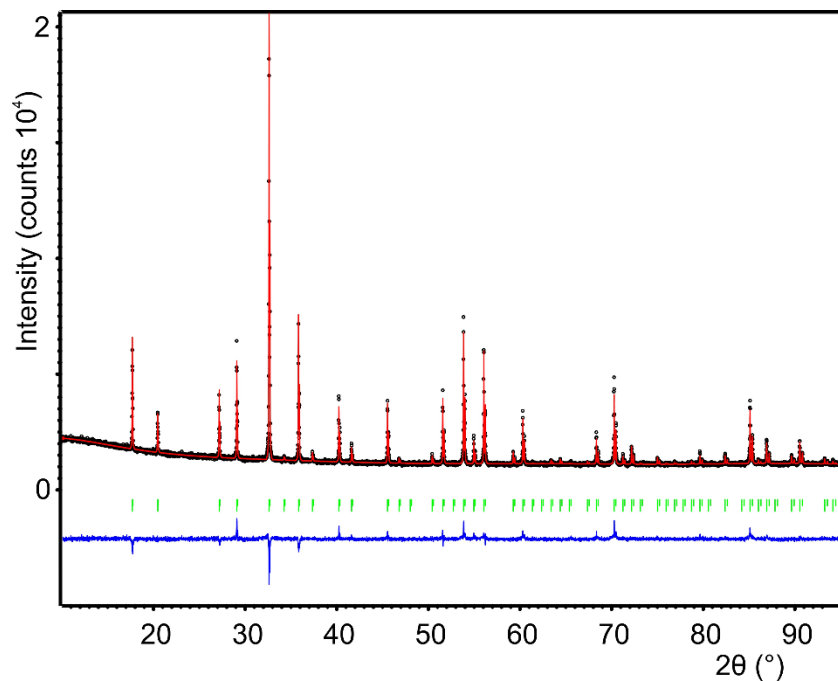


Figure S2: Result of Rietveld refinement of the non-codoped GGAG:Ce. The black points represent the measured pattern, the red line corresponds to the calculated pattern, the blue curve is the difference between the measured and calculated data, and the green bars show Bragg positions.

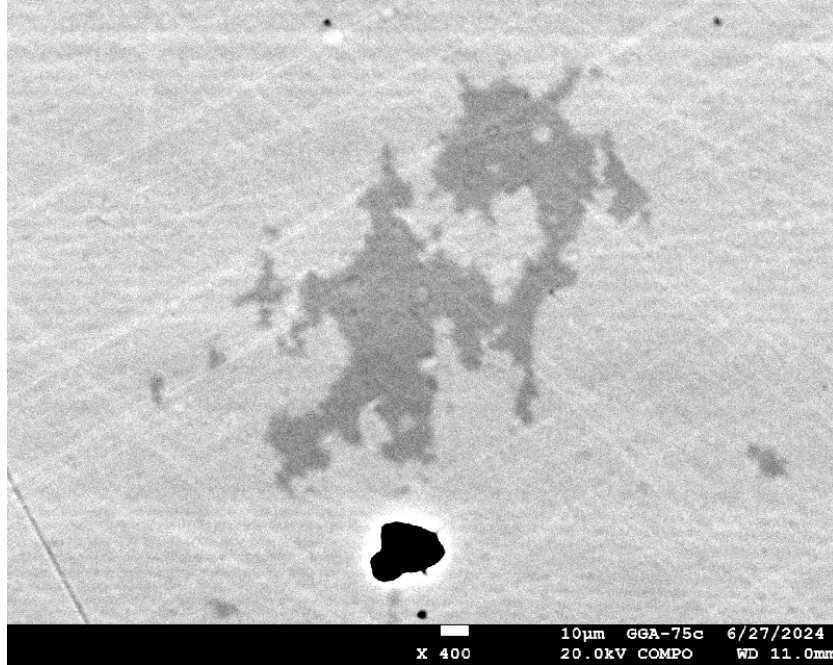


Figure S3: BSE image of secondary phase (light grey islands) within GGAG:Ce codoped with 6.21 at.% of Ho³⁺. Black spot in the central bottom is an instrumental effect.

REFERENCES

1. Jain A, Ong SP, Hautier G, Chen W, Richards WD, Dacek S, et al. Commentary: The Materials Project: A materials genome approach to accelerating materials innovation. *APL Materials*. 2013 Jul;1(1):011002.