

Scintillation properties of LuAG:Ce ceramic and single crystal materials

Jiří A. Mareš¹, Alena Beitlerová¹, Martin Nikl¹, Shuping Liu^{1, 2}, Yubai Pan²,
and Carmelo D'Ambrosio³

¹*Institute of Physics, Acad. of Sciences of the Czech Republic, Cukrovarnická 10, 162 00
Praha 6, Czech Republic*

²*Key Lab. of Transparent Opto-functional Inorganic Materials, Chinese Acad. Sci.,
200050 Shanghai, China*

³*CERN, PH-LHB group, Geneva 23, CH1211 Switzerland*

An intense studies and research of Ce³⁺-doped heavy and fast lutetium based Lu₃Al₅O₁₂ (LuAG) garnet scintillation crystals started around year 2000 [1]. Detailed properties of LuAG:Ce single crystal were summarized by M. Nikl et al. in paper [2]. Besides LuAG:Ce scintillating crystal also LuAG:Ce ceramics were prepared and investigated from year 2005 [3,4]. LuAG:Ce ceramics are characterized with no antisite-based shallow electron traps which are present in the Czochralski grown LuAG:Ce single crystals [4]. Besides LuAG:Ce ceramics also LuAG:Pr ones were prepared [5].

In this talk we will present the newest results of scintillating properties of LuAG:Ce ceramic and single crystal materials including a comparison between them. Scintillating properties as light yield, energy resolution (both the photopeak ones and the photo-escape ones) and non-proportionality were measured by a HPMT photomultiplier under various radioisotope excitation [6]. Different LuAG:Ce ceramics were studied as (i) Mg co-doped ones, (ii) nonstoichiometric ones (with an excess of Lu) and an influence of annealing (both on ceramics and single crystals). The latest development of LuAG:Ce ceramics resulted in high performance materials with the same light yield 27000 ph/MeV as that of LuAG:Ce single crystals.

- [1] M. Nikl, E. Mihokova, J.A. Mares, A. Vedda, M. Martini, K. Nejezchleb and K. Blazek, *Phys. Stat. Sol. A*181 (2000) R10.
- [2] M. Nikl, A. Yoshikawa, K. Kamada, K. Nejezchleb, C.R. Stanek, J.A. Mares and K. Blazek, *Prog. in Cryst. Growth and Characterization* 59 (2013) 47.
- [3] H.-L. Li, X.-J. Liu, R.-J. Xie, Y. Zeng and L. Ping Huang, *J. Amer. Ceram. Soc.* 89 (2006) 2356.
- [4] M. Nikl, E. Mihokova, J. Pejchal, A. Vedda, Y. Zorenko and K. Nejezchleb, *physica status solidi* 242 (2005) R119.
- [5] Y. Shi, M. Nikl, X. Feng, J.A. Mares, Y. Shen, A. Beitlerova, R. Kucerkova, Y. Pan and Q. Liu, *J. Appl. Phys.* 109 (2011) 013522-1.
- [6] J.A. Mares, A. Beitlerova, P. Prusa, K. Blazek, P. Horodysky, K. Kamada, A. Yoshikawa, C. D'Ambrosio and M. Nikl, to be published in *J. Lumin* (2015).