TRANSPARENT GYAGG:CE SCINTILLATION CERAMICS FABRICATED BY DLP STEREOLITHOGRAPHY*

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Crystalline materials based on complex oxides $(Gd,Y)_3Al_2Ga_3O_{12}$:Ce (GYAGG:Ce) with a garnet-type structure are promising scintillation and luminescent materials [1-4]. The ceramic production method, which provides a high level of transparency, has advantages over single crystal production due to its ability to achieve an affordable price for the product. Thus, the development of techniques to make ceramics manufacturing more cost-effective is greatly desired.

For the first time, polycrystalline transparent ceramics (see figure) have been obtained using a cheap, simple and commercially available an Anycubic Photon Ultra DLP 3D printer for green body formation and subsequence debinding, and pressureless sintering processes at 1650°C in an oxygen atmosphere. According to scanning electron microscopy, 3D printed GYAGG:Ce ceramics contain a small amount of residual pores and inclusions.

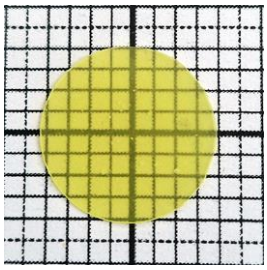

Fig.1. 3D printed transparent GYAGG:Ce ceramics, dia. 15 mm, thickness 0.5 mm.

The major functional properties of the 3D manufactured ceramic samples are similar to those obtained using the traditional method, which involves uniaxial pressing to produce green bodies. The photoluminescence and photoexcited spectra of the ceramic exhibit a typical profile for the Ce^{3+} ion in the garnet oxide matrix. The effective photoluminescence decay time was ~62 ns. Light output under 662 keV was measured to be 43–45 photons/keV.

The ability to produce transparent ceramics through the use of 3D printing technology is being debated. The advantages of using UV-curable slurries that contain GYAGG:Ce microcrystalline powder, which was obtained through coprecipitation and thermal treatment [4], are being promoted. However, there are also limitations due to the need for phosphorus-free dispersing additives [5,6] to stabilize and reduce the viscosity of the slurries.

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