Contribution ID: **148** Type: **Oral presentation**

Garnet scintillators, obtained by 3D printing

Tuesday 19 September 2017 09:30 (15 minutes)

Scintillation ceramics attracts attention for last two decades due to several potential advantages: lower production costs compared to single crystals, possibility to achieve high scintillation light yield and flexibility of composition. With a help of modern additive technology additional benefit arises –ceramic materials could be 3D-printed, which provide a new level of possibility to create a material with complex geometry. We report our latest results on 3D-printing of complex oxide garnet scintillators.

YAG:Ce scintillating material was obtained using a stereophotolithograpy approach for the first time. YAG:Ce nanopowder was synthesized by co-precipitation, then it was mixed with photocurable resin and surfactants to form a slip with volumetric bulk content ˜25%. Then it was photocured layer by layer in stereophotolithograpy 3D printer to form a polymer-binded green body. Green body was carefully debinded and sintered at 1600 ℃, which gave translucent ceramic objects with density ˜98% of a single crystal.

Luminescence properties were found to be typical for Ce3+ doped YAG. Ceramics demonstrated challenging scintillation characteristics –average decay constant τsc under 60 ns and light yield measured under 5,5 MeV α-particles excitation was found to be more than 60% higher compared to YAG:Ce single crystal. This is an ongoing research, and new results will be included into the talk.

The method developed may be useful to produce composite materials, sophisticated luminophores with a complex surface for LED lighting devices, complex shape scintillators for improved characteristics or special detector properties. Particularly, neutron detection materials could be produced by printing a complex permeable form and filling it with neutron moderator/absorber. 3D-printing allows obtaining virtually any geometrical form, including those, which could not be obtained by any other approach. The goal of this talk is to induce creativity to find applications to this new scintillator forming method.

Work is supported by grant № 14.W03.31.0004 of Russian Federation Government.

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Session Classification: Crystal growth

Track Classification: S05_Crystal Growth (Orals)