

## Photoluminescence and Thermoluminescence of the Oxygen-Deficient YAG, YAP and YAM Phosphors

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Application potential of the carbon-doped  $Y_3Al_5O_{12}$  (YAG:C) for radiation dosimetry using the thermoluminescence (TL) or the optically stimulated luminescence (OSL) techniques has been shown recently [1]. In particular, the OSL sensitivity of the non-optimized YAG:C to  $\beta$ -radiation ( $^{90}Sr/^{90}Y$ , 10 mGy) was found to be about 0.1 of the commercial  $\alpha$ - $Al_2O_3:C$ .

The present work was aimed to check the photoluminescent and thermoluminescent properties of YAG:C phosphor and to compare them with other yttrium-aluminum oxides of  $YAlO_3$  (YAP) and  $Y_4Al_2O_9$  (YAM).

For this purpose, the nominally pure compounds of YAG, YAP and YAM in the form of nanopowders have been synthesized by the solution combustion method using urea as a fuel, as described in [2]. The solid ceramic samples have been prepared from the obtained nanopowders at 1000-1500 °C in strongly reducing conditions (pure  $N_2$  gas atmosphere + graphite equipment). Besides, doping with carbon (from 1 to 5 wt.%) was used. Similar ceramic samples, however without carbon doping and prepared in oxidizing conditions (in air), were studied for comparison as well. The obtained powder and ceramic materials were controlled by the X-ray powder diffraction (XRD) and scanning electron microscopy (SEM) techniques.

The work presents results on photoluminescence, photoluminescence excitation, TL and OSL properties of the materials after exposure to UV- (250-400 nm) or ionizing  $\gamma$ - ( $^{60}Co$ ) and  $\beta$ - ( $^{90}Sr/^{90}Y$ ) radiations. The observed luminescent properties of the materials are related to the F-type centers created on the basis of oxygen vacancies, antisite ( $Y_{Al}$ ) defects and uncontrolled  $Tb^{3+}$  impurity ions.

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- [1] M.S. Kulkarni et al., Carbon doped yttrium aluminum garnet (YAG:C) – A new phosphor for radiation dosimetry, *Radiat. Meas.* **43** (2008) 492-496.
- [2] Ya. Zhydachevskii et al., Thermoluminescent properties of Mn-doped  $YAlO_3$  synthesized by the solution combustion method, *Opt. Mater.* **37** (2014) 125-131.