Raman and luminescent spectroscopy of Ce^{3+} doped $Tb_3Al_5O_{12}$ single crystalline film phosphors grown onto $Gd_3Al_{2.5}Ga_{2.5}O_{12}$ and $Y_3Al_5O_{12}$ substrates

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Nowadays the luminescent materials in form of single crystalline film (SCF) based on various oxide compounds are mainly produced by the liquid phase epitaxy growth method [1]. Furthermore, novel composite scintillators and white LED converters based on SCFs and single crystal (SC) substrates with the same crystalline structure (homoepitaxy) or a near crystalline structure (quasi-homoepitaxy) are also made using LPE technology [2]. The examples of such efficient luminescence materials are SCF of Tb3Al5O12:Ce (TbAG:Ce) garnet, grown onto undoped Gd3Al2.5Ga2.5O12 (GAGG) and Y3Al5O12 (YAG) SCs substrates [3].

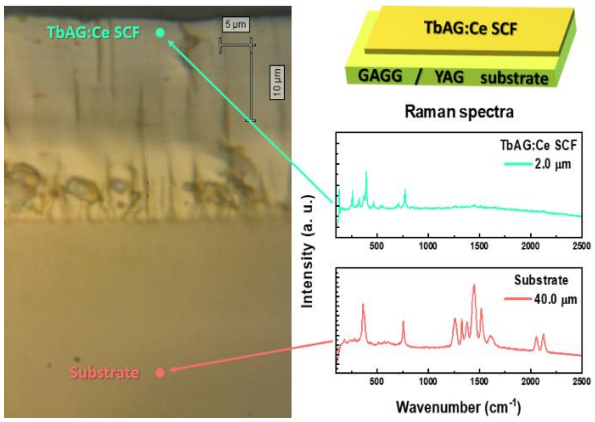

Fig. 1. Microphoto of the epitaxial structure, as well as its scheme, with indicated initial and ending point of Raman spectra

This work represents our last investigation of the cross-section of TbAG:Ce SCF/GAGG SC and TbAG:Ce SCF/ YAG SC epitaxial structures, using the Raman spectroscopy. For both quasi-homoepitaxy grown composites, a clear distinction between SCF and the substrate was achieved using Raman spectroscopy. The interaction of TbAG.Ce films and different GAGG and YAG substrates can lead to changes in the optical properties of the films caused by significant mechanical stresses at the SC/SCF interface due to various differences in the lattice constants for SC YAG and GAGG. Additionally, the presence of transition layer (TL) between TbAG:Ce SCF, and YAG, and GAGG substrates was found. It can be assumed that the chemical composition of the solution is in the TL range can be considered as (Tb3-xGdx)3Al5O12 and (Tb3-xYx)3Al5O12 solid solutions for TbAG:Ce/GAGG and TbAG:Ce/YAG structures, respectively, where x values was changed from 0 in SCF and 3 in the substrates. Evaluation of the TL from the Ce-doped film to the undoped substrate is also possible with the measurements of the Ce3+ high-precision luminescence along the cross-section of epitaxial structures. It is noticeable that the intensity of Ce3+ ion luminescence changes with the measurement position and is completely attenuated upon passing through the transition layer.

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