Contribution ID: **128** Type: **Poster presentation**

Single crystalline film scintillators based on the Ce3+ doped Ca2RMgScSi3O12:Ce (R=Y, Lu) garnets

Wednesday 20 September 2017 10:20 (1 minute)

In this work, we present for the first time the results on crystallization and investigation of the luminescent and scintillation properties of new prospective scintillators based on the single crystalline films (SCFs) of Ce3+ doped Ca2RMgScSi3O12 (R=Y, Lu) silicate garnet, grown by the liquid phase epitaxy (LPE) method onto Y3Al5O12 (YAG) substrates. The luminescent properties of Ca2RMgScSi3O12:Ce SCFs were compared with the properties of the reference YAG:Ce and LuAG:Ce SCF samples. The influence of the thermal annealing in 1000-1300oC range in N2/H2 reducing atmosphere on the optical and scintillation properties of Ca2RMgScSi3O12:Ce SCFs was investigated as well.
We have observed the formation of two types of Ce3+ centers in the Ca2RMgScSi3O12:Ce garnets in the emission and excitation spectra as well as in the decay kinetics of the Ce3+ luminescence in the SCFs (). These two types centers (labeled as Ce1 and Ce2) possess different local surroundings due to substitution by the Ce3+ ions of the different types of cations (correspondingly R3+ and Ca2+) in the dodecahedral positions of garnet host. Ce1 and Ce2 centers in Ca2RMgScSi3O12 garnets are characterized by the differing spectral behaviors (the positions of the emission and excitation bands, Stokes shift and decay time of Ce3+ photoluminescence) due to the different crystal field strength in the various dodecahedral sites for localization of Ce3+ ions.
We have observed also the formation of Ce4+ and Ce3+ valence states of Ce in the SCF of Ca2RMgScSiO12:Ce garnets due to the non-uniform distribution of the Ca2+, Mg2+ and Si4+ cations, and charge compensation requirement. The presence of Ce4+ ions in as grown SCF samples is confirmed by the presence of absorption due to the O2+-Ce4+ transitions in the UV range. The Ce4+ centers are also responsible for acceleration of the initial stage of the cerium photoluminescence decay and presence of the fast components with the lifetime in the few ns range in Ca2YMgScSi3O12 SCF. The Ce4+ –> Ce3+ recharging in these SCF is achieved by annealing of the samples in the reducing atmosphere at temperatures above 1000oC. Such thermal treatment leads also to more exponential-like decay kinetics of the Ce3+ luminescence in Ca2RMgScSi3O12:Ce SCF and enables the study of the energy transfer processes between the different Ce3+ multicenters in these garnets.
The results of this research can be suitable for the development of new generation of scintillators based on the epitaxial structures of Ca2+-Si4+ containing garnets, grown by LPE method onto undoped or doped substrates of garnet compounds for registration of the different components of mixed ionization fluxes as well as for the microimaging technique.

Acknowledgements: The work was performed in the framework of NCBR NANOLUX #286 project and partly also supported by Polish NCN 2016/21/B/ST8/03200 project and Ministry of Education and Science of the Ukraine SF-20 F project.

Has accepted

Author: ZORENKO, Yuriy (Instytut of Physics University in Bydgoszcz)

Co-authors: Dr GORBENKO, Vitalii (Institute of Physics, Kazimierz Wielki University in Bydgoszcz, Poland); Ms ZORENKO, Tetiana (Institute of Physics, Kazimierz Wielki University in Bydgoszcz); Ms ISKALIYEVA, Aizhan (Institute of Physics, Kazimierz Wielki University in Bydgoszcz); Dr PAPROCKI, Kazimierz (of Physics, Kazimierz Wielki University in Bydgoszcz); Prof. FABISIAK, Kazimierz (Institute of Physics Kazimierz Wielki University in Bydgoszcz); Mr SCHRÖPPEL, Felix (Institute of Materials for Electronics and Energy Technology (i-MEET), Department of Materials Science and Engineering VI, University of Erlangen-Nürnberg); Ms OSVET, Andres (Institute of Materials for Electronics and Energy Technology (i-MEET), Department of Materials Science and Engineering VI, University of Erlangen-Nürnberg); Prof. BATENTSCHUK, Miroslaw (Institute of Materials for Electronics and Energy Technology (i-MEET), Department of Materials Science and Engineering VI, University of Erlangen-Nürnberg)

Presenter: ZORENKO, Yuriy (Instytut of Physics University in Bydgoszcz)

Session Classification: Poster Session 2

Track Classification: P2_crystalgrowth