Luminescence of the Sc^{3+} isoelectronic impurities and antisite defects in $(Y,Lu,Gd)_3Al_5O_{12}$ garnets

Artur Majewski-Napierkowski[1#], Jan Pejchal[2], Martin Nikl[2], Karol Bartosiewicz[1], Yuriy Zorenko[1]

[1]Faculty of Physics of Kazimierz Wielki University, 85-090 Bydgoszcz, Poland
[2]Institute of Physics, Czech Academy of Sciences, 16200 Prague, Czech Republic

The isoelectonic impuries (*IsIm*) can serve as very effective emission centers in UV range in semiconductors [1] and dielectrics [2]. Generaly, the ability of *IsIm* for the creation of emission centers is defined by the value of non-Coulomb potential (NCP) which appears due to the substitution of core ions by the *IsIm* in dodecahedral and octahedral positions of the garnet lattice. The value and sign of NCP depends on: i) ability of *IsIm* for the substitution of core cations in their regular positions of garnet host; ii) difference ΔR of ionic radii for *IsIm* and core cation and iii) variance between the core and electronic shell of *IsIm* and host cations [3]. Namely, at the reaching of critical value of NCP, the *IsIm* and aniti-site defects (ADs) such as Y_{Al}, Lu_{Al}, Sc_{Al}, Sc_{Y} or Sc_{Lu} cause the formation of separated levels in forbidden gap of the garnet host acting as centers for localization of host excitons and localization of the electrons or holes. The recombination of free carriers from the conduction and valence bands with the electrons or holes, localized at the mentioned centers leads to radiative annihilation of excitons *localized* and *bound* with *IsIm* and ADs and the appearance of the additional emission bands in UV range [4].

This work is the continuation of the previous studies [3, 4] on the regularities of the luminescence centers formation by the ADs and Sc^{3+} *IsIm* in the $(Y,Lu,Gd)_3Al_5O_{12}$ garnet compounds. Such regularities have been revealed also for the ADs (Y_{Al} , Lu_{Al} and Gd_{Al} in (Y,Lu,Gd)AG hosts), *as special kinds of IsIm* [3]. Creation of such type of ADs in the concentration even up to 0.25-0.3 at.% is the irrevocable consequence of the single crystals (SC) growth of these garnets from high-temperature melt at 1800-2000°C. Conversely, the single crystalline films (SCF) of these garnets grown by the liquid hase epitaxy (LPE) method are free from ADs due to low (~1000°C) temperature of their crystallization. Therefore, the SC and SCF of (Y,Lu,Gd)AG garnets are the convenient objects for the investigation of radiative relaxation of low-energy excitations in garnet compounds, in particular exciton luminescence, connected with *IsIm* and AD centers [3, 4].

Peculiarities of the luminescence and excitation energy transfer from the garnet host to the emission centers formed by Sc^{3+} *IsIm* and ADs have been studied in SCs and SCFs of undoped and Sc^{3+} doped (Y,Lu,Gd)AG garnets using convetional spectral methods as well as the luminescent spectroscopy under excitation by pulsed synchrotron radiation (SR) with energy in the 3.7-12.5 eV range at new Superlumi stations at P66 line at Pertra III storage rings at DESY, Germany.

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corresponding author: arthur@ukw.edu.pl