Radio- and photoluminescence of mixed $(Lu_x,Y_{1-x})AG:Pr$ and doubly doped LuAG:Pr,Mo scintillator crystals

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5th IWASOM Gdansk 2015 — International Workshop on Advanced Spectroscopy and Optical Materials

I Introduction

Mixed $(Lu_x,Y_{1-x})_3Al_5O_{12}$ crystals doped with praseodymium and molybdenum have been examined and are reported in this presentation. In this communication we present the results of room temperature and low temperature measurements of radio- and photoluminescence spectra performed on a series of $(Lu_x,Y_{1-x})_3Al_5O_{12}$:Pr crystals (x = 0.00, 0.25, 0.50, 0.75,1). The differences between these spectra are not trivial and suggest that the mechanism of energy transfer from the host to the activating ions is more complicated than usually assumed [1,2].

II Materials and experiments

All samples (plates, 5x5x1mm) investigated in these experiments were cut from the boules grown by the Czochralski method at Institute of Electronic Materials Technology in Warsaw, Poland. Radioluminescence spectra were measured at the National Laboratory of Quantum Technologies (NLTK) and photoluminescence spectra were measured at the Center of Quantum Optics (COK), both at Institute of Physics, Nicolaus Copernicus University in Toruń, Poland.

III Experimental setup

Photoluminescence measurement system consisted of :

- Acton SP-2300i as excitation monochromator
- Acton SP-150 as emission monochromator
- Actron SpectraHub
- LakeShore 331S temperature controller
- Advanced Research System Inc DE-202PE closed-cycle helium cooler
- Princeton Instruments xenon lamp model XS432
- Hamamatsu 1P28 photomultiplier

Radioluminescece measurement system consisted of :

- Acton SpectraPro 500i monochromator
- Acton SpectraHub
- LakeShore 330 temperature controller
- APD Cryogenics Inc. closed-cycle helium cooler
- Inel XRG3500 X-ray generator (Cu-anode tube, 45 kV / 10 mA)
- Hamamatsu R928 photomultiplier

IV Experimental results

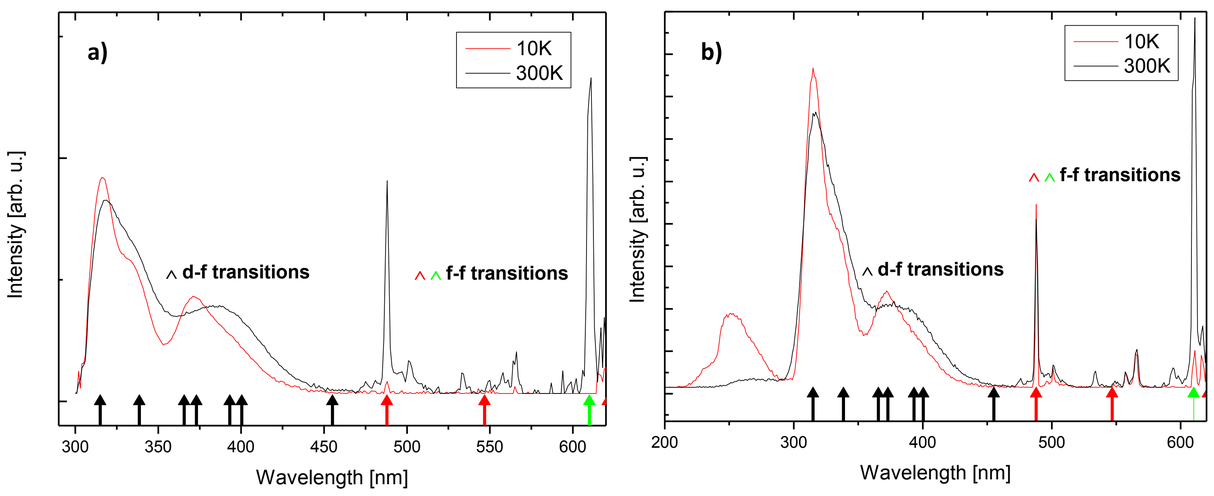

Fig.1. YAG:Pr(0.17%) **(a)** photoluminescence (λexc = 275nm), **(b)** radioluminescence spectra

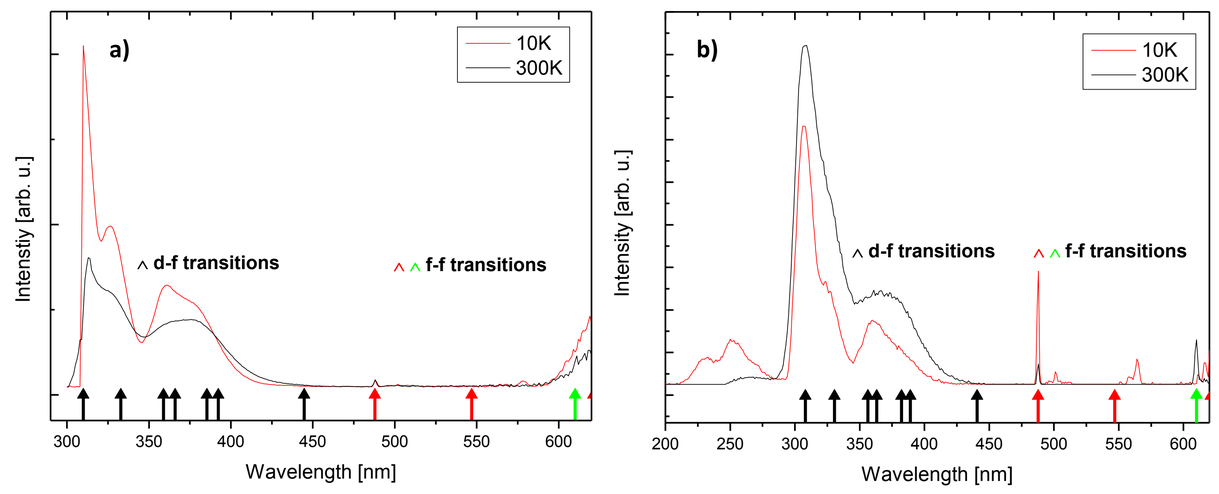

Fig.2. LuAG:Pr(0.12%) **(a)** photoluminescence (λexc = 290nm), **(b)** radioluminescence spectra

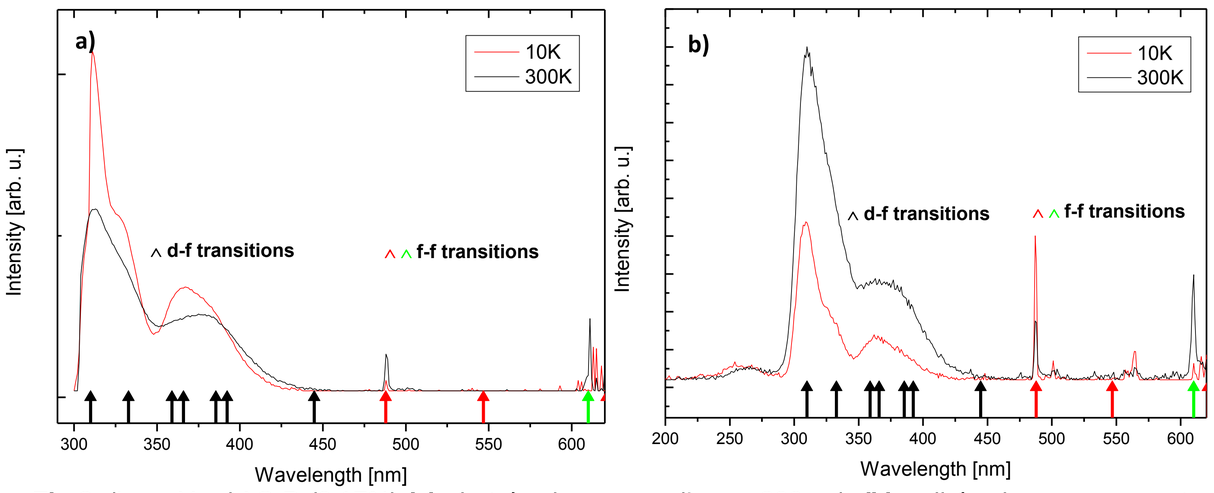

Fig.3. $(Lu_{0.75}Y_{0.25})AG:Pr(0.17\%)$ **(a)** photoluminescence (λexc = 290nm), **(b)** radioluminescence spectra

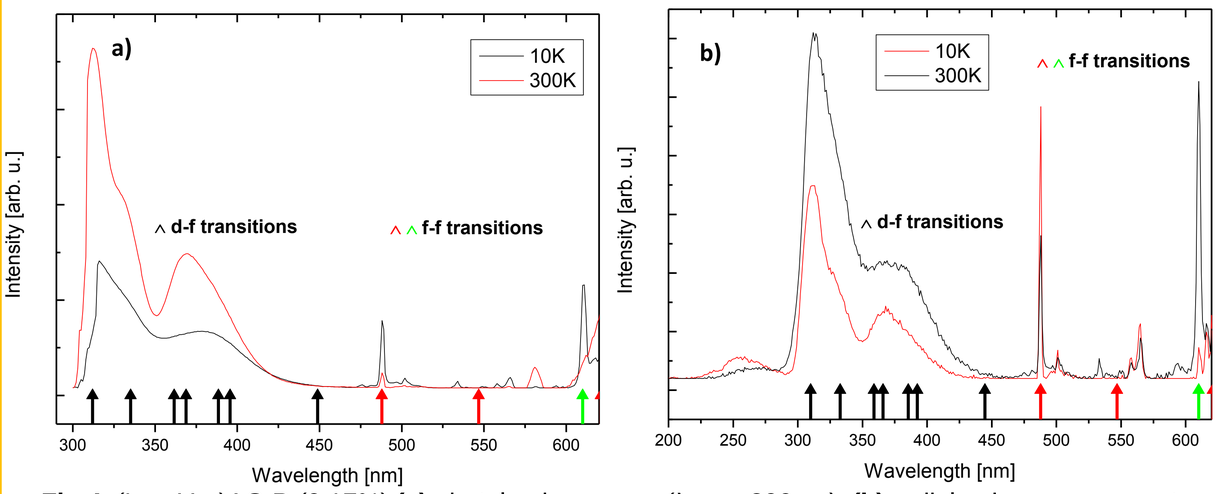

Fig.4. $(Lu_{0.5}Y_{0.5})AG:Pr(0.17\%)$ **(a)** photoluminescence (λexc = 290nm), **(b)** radioluminescence spectra

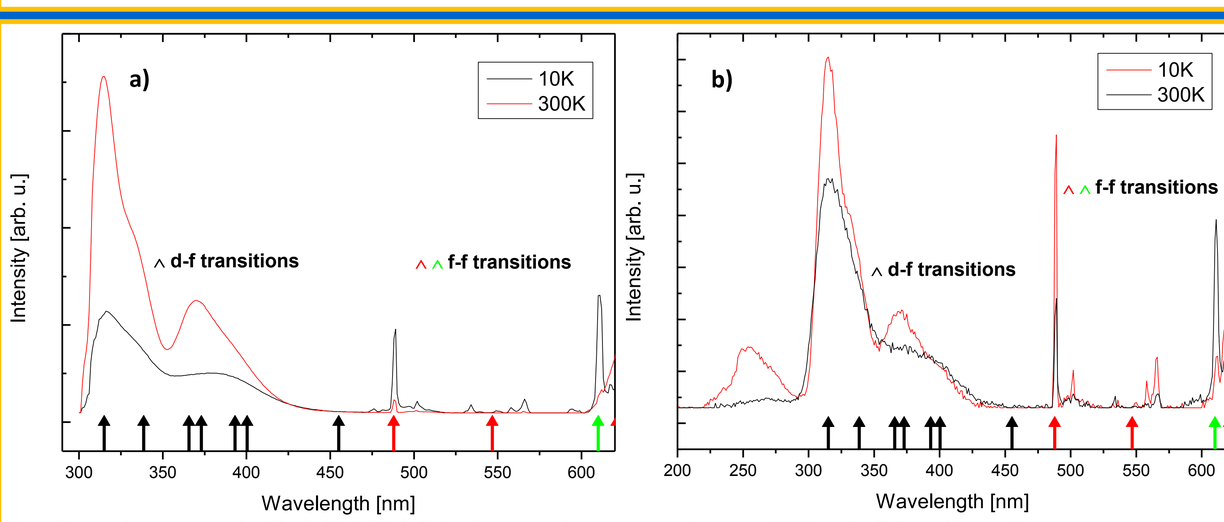

Fig.5. $(Lu_{0.25}Y_{0.75})AG:Pr(0.18\%)$ **(a)** photoluminescence (λexc = 290nm), **(b)** radioluminescence spectra

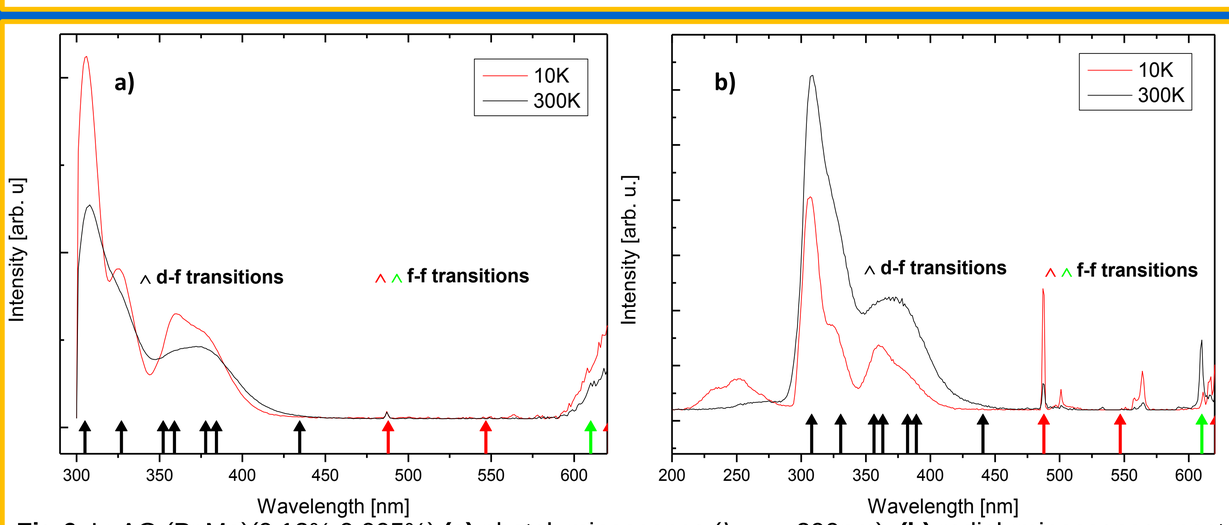

Fig.6. LuAG:(Pr,Mo)(0.12%,0.005%) **(a)** photoluminescence (λexc = 290nm), **(b)** radioluminescence spectra

V Conclusions

Radio- and photoluminescence of mixed $(Lu_x,Y_{1-x})AG:Pr$ and doubly doped LuAG:Pr,Mo scintillator crystals have been investigated. The measured spectra have been corrected for the spectral sensitivity of the photomultipliers. The intensity of wide emission bands, assigned to d-f transitons of Pr^{3+} ion, shows typical temperature dependence, unlike the narrow bands assigned to f-f transitions (e.g. the $^3P_0 - {}^3H_4$ line at 488nm) [3]. The host emission band at 250nm clearly visible in radioluminescence spectra shows thermal quenching even stronger then that of d-f emission [4]. In general the intensity of f-f lines is stronger in radioluminescence spectra and for higher ratio of yttrium to lutetium.

These observations are consistent with the assumption that there is an additional channel of energy transfer from the host to the Pr ions [5]. The similiar situation has been reported earlier in BaF_2 :Pr [6]. Since the contribution of Pr-bound exciton was there confirmed directly we can assume that the similar mechanism is also achive in $(Lu_x,Y_{1-x})AG:Pr$. No effects assosciated with Mo-doping have been noted.

VI References

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VII Acknowledgements

The project has been financed from the funds of the Polish National Science Centre granted on the basis of Decision no. DEC 2012/05/B/ST5/00324.

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