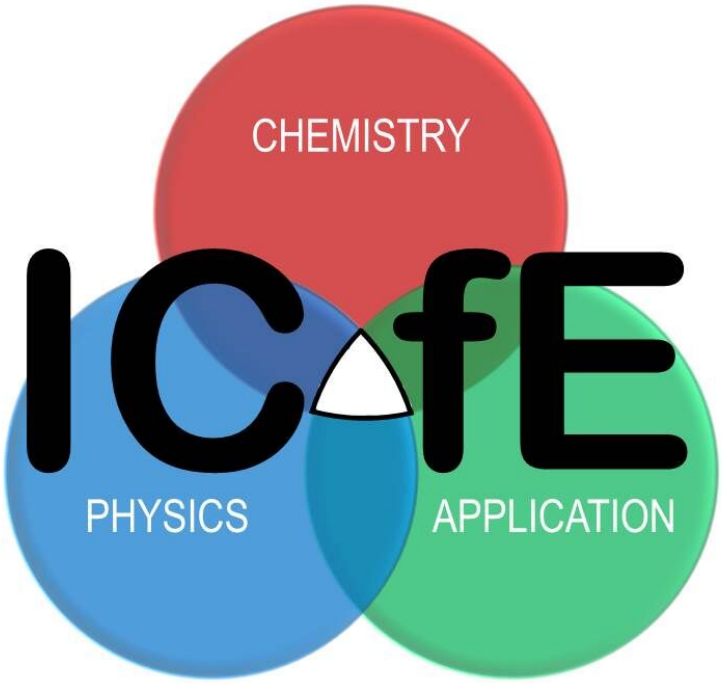

ICfE 9 Oxford

September 6-9 2015

The 9th International Conference on f-Elements 2015, Oxford.
The conference of the European Rare Earth Society (ERES)

Programme and Book of Abstracts

MC-02

NANOMATERIALS SYNTHESIS BY BENZENETRICARBOXYLATE METHOD

Ivan G.N. Silvaa, Danilo Mustafaa, Lucas C.V. Rodriguesa, Maria C.F.C. Felintob, Hermi F. Britoa,*
a Instituto de Química, Universidade de São Paulo, São Paulo, Brazil
b Centro de Química e Meio Ambiente, IPEN, São Paulo, Brazil

With improvements made lately in the nanoscience and nanotechnology, the photonic, structural and morphological properties of the RE_2O_3 doped with Eu^{3+} nanomaterials (RE^{3+}: Y, Gd and Lu) have been widely investigated [1]. In the thermolysis route, it is of great advantage to use the [RE(TLA)] complexes as precursors (TLA: 1,2,4-benzenetricarboxylate) to produce the cubic RE_2O_3 materials (500–100°C). The thermogravimetric curves of the [RE(TLA):Eu (x mol%)] complexes (RE^{3+}: Y, Gd and Lu; x = 0.1, 0.5, 1.0 and 5.0) shows that the organic moiety decomposes in a single-step from 430 to 580 °C, leading to the formation of RE_2O_3 at 500 °C [2]. The decomposition temperature decreases for all complexes with increasing Eu^{3+} concentration. The excitation e emission spectra of the systems present the characteristic emission of the Eu^{3+} ion. The excitation spectra show a broad oxide to europium charge transfer absorption band at 260 nm, i.e. $O^{2-}(2p) \rightarrow Eu^{3+}(4f^6)$ LMCT, as well as the narrow lines assigned to the $4f^6$ intraconfigurational transitions of the Eu^{3+} ion. The increase of the annealing temperature decreases the value of the Ω_2 intensity parameter. We believe that the Eu^{3+} could migrate from the C_2 sites (non-centrosymmetric) to S_6 (centrosymmetric) at higher temperatures reducing the overall Ω_2 value. The optical results are consistent with the low symmetry of the C_2 site occupied by the Eu^{3+} ion in the cubic C-type $RE_2O_3:Eu^{3+}$, which is essential for optical applications. In conclusion, the $Y_2O_3:Eu^{3+}$ nanophosphors exhibit high values of emission quantum efficiency, compatible with the commercial phosphors currently available in the photonic

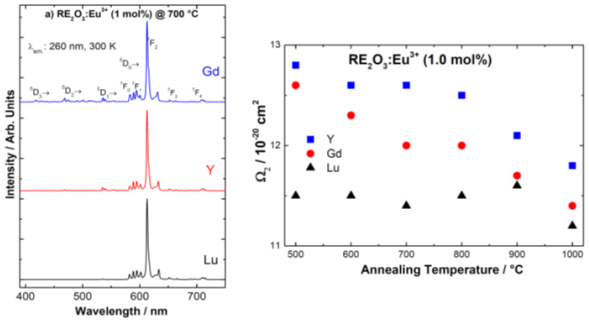

Figure 1. a) Emission spectra of $RE_2O_3:Eu^{3+}$ (1.0 mol%) materials (RE^{3+}: Y, Gd and Lu) and b) variation of the Ω_2 experimental intensity parameter with the annealing temperature.

References

[1] R.M.K. Whiffen, Z. Antic, A. Speghini, M.G. Brik, B. Bártová, M. Bettinelli, M.D. Dramicanin, Opt. Mater. 36 (2014) 1083.
[2] I.G.N. Silva, L.C.V. Rodrigues, E.R. Souza, J. Kai, M.C.F.C. Felinto, J. Hölsä, H.F. Brito, O.L. Malta, Opt. Mater. 40 (2015) 41.

MC-03

CHEMICAL AND HYDROSTATIC PRESSURE EFFECTS ON SPECTROSCOPIC PROPERTIES OF Nd^{3+}-DOPED GALLIUM NANO-GARNETS

Virginia Monteseguro,[a] Kei Kamada,[b] Akira Yoshikawa,[c] Juan E. Muñoz-Santiuste,[d] Ulises R. Rodríguez-Mendoza,[a] Antonio D. Lozano-Gorrín,[a] Mamilla Rathaiah,[e] Inocencio R. Martín,[a] Vemula Venkatramu,[e] and Víctor Lavín[a,]*
[a] Departamento de Física, and MALTA Consolider Team, Universidad de La Laguna. E-38200 San Cristóbal de La Laguna, Santa Cruz de Tenerife, Spain.
[b] New Industry Creation Hatchery Center (NICHe), Tohoku University. 6-6-10 Aoba, Aramaki, Sendai 980-8579, Japan.
[c] Institute for Materials Research, Tohoku University, 2-1-1 Katahira, Sendai 980-8577, Japan
[d] Departamento de Física Aplicada, and MALTA Consolider Team, Universidad Carlos III de Madrid. Av. del Mediterráneo s/n, Leganés, Madrid, Spain.
[e] Department of Physics, Yogi Vemana University. Kadapa 516 003, India.

Matter under extreme conditions of pressure is the subject of multidisciplinary studies that join such diverse fields as physics, chemistry, material science, geology, microbiology, or food technology. One of the most interesting goals of the high pressure technique is that provides a unique insight into the electronic structure and optical properties of materials doped with rare earth (RE^{3+}) ions, since it can vary the structure, the coordination environment and, consequently, the electric, magnetic, vibrational, and optical properties.[1] On the other hand, the use of the trivalent Neodymium (Nd^{3+}) ion-doped inorganic materials have attracted great attention in many areas, from science research to industry applications. Garnets have always been attractive gain media for laser applications due to their high mechanical strength and good thermal and optical properties. In this sense, much efforts have been spent in the last decade in the study of the luminescence properties of RE^{3+}-doped $Gd_3Ga_5O_{12}$ (GGG), $Y_3Ga_5O_{12}$ (YGG) and $Lu_3Ga_5O_{12}$ (LuGG) nanocrystalline garnets, especially as an alternative to quantum dots in photonic devices.
We propose the comparative study of the effects of chemical and hydrostatic pressures on the structural, vibrational and optical properties of the Nd^{3+} ion in a series of $RE_3Ga_5O_{12}$ rare earth gallium crystalline and nano-crystalline garnets when the size of the RE^{3+} (=Gd^{3+}, Y^{3+}, Lu^{3+}) changes. Pressure will modulate the structural, vibrational and elastic properties of the garnet. In addition, the crystal-field interaction felt by the RE^{3+} ions is expected to be different in these three host lattices due to the magnitude of the size mismatch with the ligands. The size effects also generate stresses, strains and rearrangements in the first coordination sphere of the Nd^{3+} optically active ion. Further modifications in the free ion interactions and/or in the crystal-field, and hence, in the optical properties are then induced when hydrostatic pressure is applied.

References

1 Th. Tröster, Optical studies of non-metallic compounds under pressure, in Handbook on the Physics and Chemistry of Rare-earths, (eds.) K. A. Gschneidner, Jr., J-C.G. Bünzli, and V. K. Pecharsky, Elsevier Science B.V., vol. 33, pp. 515 (2003).