Lanthanide(III) Species as Potential Single Component White Light Emitters

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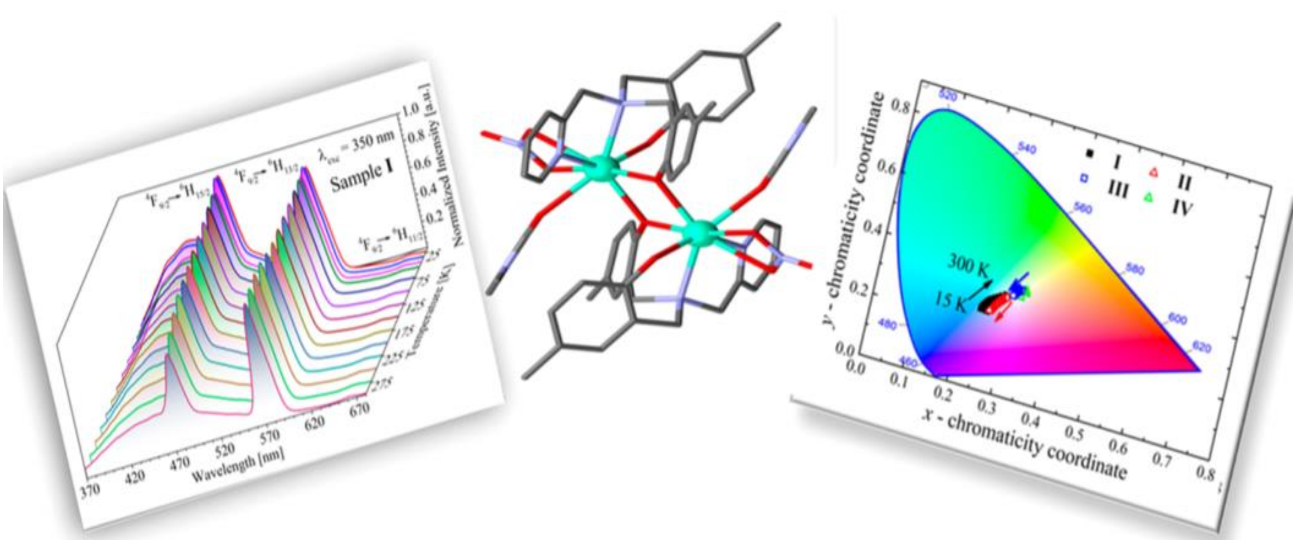
Graphical Abstract



Abstract

Due to their proven applications, lanthanide based materials are nowadays being intensely investigated. Despite the low absorption coefficients of the Laporte forbidden inner *4f-4f* transitions of the lanthanide ions, the coordination of these metal ions to ligands with high molar absorption coefficients that serve as "antenna", avoids such disadvantage leading to strong emissions. The "antenna effect" or "luminescence sensitization" is generally accomplished when the energy of the excited state of the ligand is slightly higher than the emissive energy level of the lanthanide [**1**].

Therefore, the design of ligands is very important, since it will determine the absorption of energy by the cromophore (ligand), and also the energy level of the excited state that will determine the optimal energy gap to produce the energy transfer between the cromophore and the metal ion. Since the spectroscopic area of lanthanide emission has been and is being thoroughly investigated, nowadays a new field of research has become important, that is, the preparation of white light emitters. The design of white light emitters is of interest due to the potential applications of these in white organic light-emitting diodes (WOLEDs), which are used in solid–state lighting and flat-panel displays.

Different strategies are known to be useful for the preparation of materials with white emitting properties. Besides the well-known doped materials, it is possible to prepare single phase white emitting materials, which can be either molecular or polymeric in nature. This can be principally achieved by a dichromatic strategy. This corresponds to the preparation of materials that contain blue/green emitting ligands together with yellow emitting metal centers (**B/Y**) [**2**]. Thus, taking advantage of the blue emission (**B**) contributed by the ligand, together with the simultaneous yellow luminescence (**Y**) of dysprosium(III), white light emission can be achieved by the correct balance of the **B/Y** colors. A new series of dinuclear Dy^{III} complexes, $[Dy_2(L^{CH3})_2(NO_3)_2(MeOH)_2]$ (**I**), $[Dy_2(L^{CH3})_2(NO_3)_2(DMF)_2]\cdot 2DMF$ (**II**), $[Dy2(L^{Cl})_2(NO_3)_2(DMF)_2]\cdot 2DMF$ (**III**), and $[Dy_2(L^{CH3O})_2(NO_3)_2(DMF)_2]$ (**IV**), with 2,2'-[[(2-pyridinylmethyl)imino]-di(methylene)]-bis(4-R-phenol), where R = CH_3 (**I** and **II**), Cl (**III**), CH_3O (**IV**), will be presented as potential white light emitters. At room temperature the CIE color coordinates for the Dy^{III} complexes **I**, **III** and **IV** are close to the NTSC standard value for white color. On the other hand, the CCT values at room temperature for **I**, **II** and **IV** permit to consider these complexes as candidates for white cold light emitters, being the high value of 17235 K for **II** uncommon. Furthermore, these ligands have been used to form the corresponding dinuclear complexes with Tb^{III}, presenting bright green emission. A comparative analysis will be made between the two family of dinuclear lanthanide(III) complexes.

Keywords: Dinuclear lanthanide(III) complexes, phenoxo bridged complexes, white light emitting materials.

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Biography of Presenting Author

Pablo Andrés Fuentealba Castro born in Santiago, Chile, on 9th of August 1985. His undergraduate studies were done at Universidad Tecnologica Metropolitana. He completed his graduate studies at the Universidad de Chile, receivied the diploma for the academic degree of Doctor in Chemistry. Part of his thesis was done at the Université de Rennes 1, Rennes, France, and part also at the Instituto de Fisica-Universidade de Sao Paulo, Sao Carlos, Brazil. In 2016 he was hired as part of the professional team of the Universidad de Chile, where he started to teach undergraduate students. That same year he also made a postdoctoral research stay at the "Centro para el Desarrollo de la Nanociencia y la Nanotecnología" (CEDENNA), and in 2017 he started his postdoctoral project at Universidad de Chile. His expertise is based on the synthesis of novel inorganic compounds based on 3d and/or 4f cations, through different synthetic pathways, and the characterization in solid state of different materials through single crystal and powder X-ray diffraction, combined with spectroscopic techniques. He has worked in the analysis of magnetic and optical properties of transition metal and lanthanides cations. In 2019 he was recognized as "one of the best oral communications" at a Latin American Conference (SILQCOM), and he was named as "Honour Leading Scientist", receiving an Honour Diploma at an European Conference, 26th Advanced Materials Congress, held in Stockholm, Sweden.
Nowadays, he is an Assistant Professor at Universidad de Chile. Teaching and guiding undergraduate and graduate students. He is part of the Graduate Committee of the Facultad de Ciencias Químicas y Farmacéuticas, Universidad de Chile, and in research he is mainly focused on the optical properties of lanthanide based materials.

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