



SYRACUSE UNIVERSITY

TECHNOLOGY TRANSFER AND INDUSTRIAL DEVELOPMENT

New Ligands Lead to High-Efficiency Luminescence

In new lanthanide ion complexes, the luminescence nears 80% efficiency

Lanthanide ion complexes are known to be capable of light emission and the emission colors are relatively monochromatic and thus color pure. The process of light emission is initiated by absorption of energy by the ligands surrounding the metal ion, followed by transfer of energy from the ligand to the metal ion and subsequent metal-centered light emission.

This process is called sensitization or sensitized emission. This mechanism of sensitized light emission makes lanthanide ion complexes theoretically capable of attaining an emission efficiency of 100%, provided all steps of energy transfer are optimized.

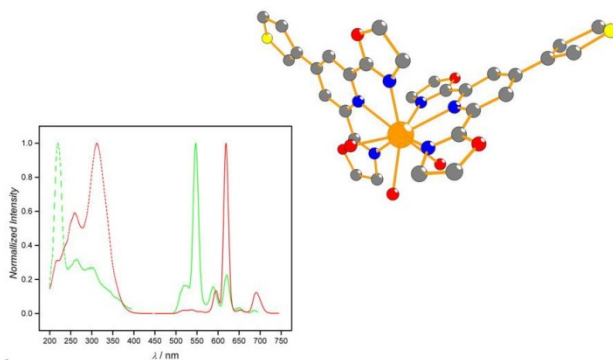
Pursuing a new theoretical pathway, the de Bettencourt-Dias research group has identified and synthesized a new member of the pyridine-bis (oxazoline) ligand family. This ligand forms highly stable complexes with lanthanide ions and the resulting new compounds have been shown to have efficiencies reported at close to 80% (Journal of the American Chemical Society, 2007, 129, pp. 15436-15437.) The ligand family itself shows enormous flexibility as it can undergo targeted modifications without detriment to the emission efficiency of the resulting metal complex.

The ligand family based on pyridine-bis (oxazoline) offers the following advantages:

- Its chemical properties enable it to strongly bind the lanthanide ions of interest.
- Its photophysical properties enable it to efficiently absorb and transfer energy to the lanthanide ions europium (a red emitter) and terbium (a green emitter).
- The ligand can easily be chemically altered at three positions to allow targeting specific analytes.

Potential applications for such energy efficient luminescent molecules include:

- Lighting – efficient light emitting diodes and pigments for color correcting CFL light bulbs
- Displays – efficient and color pure solid emitting layers for OLED-type devices
- Chemical sensors and biosensors – stable biocompatible emitters or emitting solutions that can target specific analytes.



Selected Publications

"Thiophene-derivatized Pybox and its highly luminescent lanthanide ion complexes," de Bettencourt-Dias, A.; Viswanathan, S.; Rollett, A. *J. Am. Chem. Soc.* 2007, asap.

"Lanthanide-based emitting materials in light-emitting diodes," de Bettencourt-Dias, A. *Dalton Trans.* 2007, 2229-2241.

"Exploring lanthanide luminescence in metal-organic frameworks: Synthesis, structure, and guest sensitized luminescence of a mixed europium/terbium-adipate framework and a terbium-adipate framework," de Lill, D.T.; de Bettencourt-Dias, A.; Cahill, C.L. *Inorg. Chem.* 2007, 46, 3960-3965.

"Small molecule luminescent lanthanide ion complexes - Photophysical characterization and recent developments," de Bettencourt-Dias, A. *Curr. Org. Chem.* 2007, 11, 1460-1480.

"Phenylthiophene-dipicolinic acid-based with strong solution blue and solid state green emission," de Bettencourt-Dias, A.; Poloukhine, A. *J. Phys. Chem. B* 2006, 110, 25638-25645.

"Eu(III) and Tb(III) luminescence sensitized by thiophenyl-derivatized nitrobenzoate antennas," Viswanathan, S.; de Bettencourt-Dias, A. *Inorg. Chem.* 2006, 45, 10138-10146.

"Nitro-functionalization and quantum yield of Eu(III) and Tb(III) benzoic acid complexes," de Bettencourt-Dias, A.; Viswanathan, S. *Dalton Trans.* 2006, 4093-4103.

"2-Chloro-5-nitrobenzoate complexes of Eu(III) and Tb(III) - A 1 D coordination polymer and enhanced solution luminescence," Viswanathan, S.; de Bettencourt-Dias, A. *Inorg. Chem. Comm.* 2006, 9, 444-448.

"Intermolecular forces and functional group effects in the packing structure of thiophene derivatives," de Bettencourt-Dias, A.; Viswanathan, S.; Ruddy, K. *Cryst. Growth Des.* 2005, 5, 1477-1484.

"New isophthalato-based 2D coordination polymers of Eu(III), Gd(III), and Tb(III) - Enhancement of the terbium-centered luminescence through thiophene derivatization," de Bettencourt-Dias, A. *Inorg. Chem.* 2005, 44, 2734-2741.

"Luminescent nitrobenzoate complexes of Ln³⁺: First examples of sensitization of green and red emission," de Bettencourt-Dias, A.; Viswanathan, S. *Chem. Commun.* 2004, 8, 1024-1025.

