DOCTORAL THESIS

Structural modifications to optimise lanthanide luminescence

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Date of Award:
2017

Abstract:

Luminescent lanthanide coordination complexes have attracted significant attention due to their unique optical properties. The poor absorption of a lanthanide ion can be resolved by so-called antenna effect and improve the intensity of its luminescence. Three bidentate chromophores: phosphate-pyridine chromophore, 1,2-Hydroxy pyridone (1,2-HOPO) and 2-thenoyltrifluoroacetone (TTA), functioned as both chelator and sensitizer, their energy levels are well matched with the excited state energy levels of the Eu(III) and Sm(III).

To get highly luminescent and stable lanthanide complex, we designed and synthesized various Eu(III) complexes with different backbones to compare different parameters that will affect the sensitizing efficiency of the chromophores, such as rigidity, geometry and coordination saturation.

In chapter two we combined the phosphate-pyridine chromophore with the well-studied cyclen-based chelator to fulfil the requirement of high stability and brightness. We designed a nine-coordinate europium(III) complex as platform, through coupling reactions to realise fast screen of the chromophores energy transfer efficiency.

Chapter three focuses on the structure modifications based on the chromophore of 1,2-HOPO, different chelators and backbones were compared, a europium complex **EuL4** with the highest quantum yield with this chromophore was obtained and it could goes into cells and localized on lysosome very fast. Two-phonon *in vitro* imaging was done which showed its high potential bioapplications.

Chapter four focuses on the structure modification based on the chromophore of TTA. Different backbone directly determined the europium complexes saturation number and sensitization efficiency, therefore, their quantum yields.

Table of Content