MASTER'S THESIS

Photoluminescent mechanism of trivalent lanthanide organic complexes

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Photoluminescent Mechanism of Trivalent Lanthanide Organic Complexes

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Abstract

The research on lanthanide organic complexes is a rapidly expanding field in the past four decades, largely because there are many interesting photophysical properties of *4f-4f* transitions of trivalent lanthanide ions. The potential applications are in lasers, luminescent devices, chemical and biological sensors.

The optical properties of lanthanide Schiff-based complexes in the visible range and porphyrinate complexes in near-infrared range by photoluminescent measurement have been investigated in this thesis.

In the Schiff-base lanthanide complexes, we observed that Ln(S-4N) had the highest quantum efficiency. 24% and 4% were achieved at 10K for Tb(S-4N) and Eu(S-4N) complexes respectively. In addition, we proposed a structural change taking place at low temperature. At room temperature, the pyridyl group in the complex was not coplanar to the phenyl group and it could rotate at a range of angles. As temperature decreased, the pyridyl group became more rigid and fixed at certain angle. Eventually, less energy was relaxed through non-radiative process and then the intensity of PL dramatically increased. The experimental results of the PLE spectra, the quantum yield and the lifetime, all supported this change in structure.

Novel Yb-porphyrinate complexes have also been studied. Porphyrinate ligand was used as an antenna chromophore to sensitize lanthanide luminescence. The fluorescent intensities of these complexes were determined and compared. The relation between the luminescent efficiency and the structure of complexes was deduced. It was found that the complex YbCoP had high luminescent efficiency due to broad band absorption in the visible range. The emission spectrum of YbCoP was well-split. Its peak intensity changed as a function of temperature and it was explained successfully from the proposed energy diagram using the Maxwell-Boltzmann law. Finally, ErCoP was also synthesized and characterized to exhibit high luminescence at around 1530nm, which was the suitable wavelength for optical communication.

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