

Interaction Between Eu(III) Complex and Alkylammonium Salt Leading to the Effective Emission Enhancement

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The lanthanide(III) complexes with characteristic luminescence properties like high color purity and long emission lifetime can be promising candidates for many applications such as bio-analytical sensors, electroluminescent devices and display devices.¹ Based on those wide application fields, the improvement of optical performance of lanthanide(III) attract much attention of researchers. In this study, we investigated the influence of a series of alkylammonium salts on optical properties of chiral Eu(III) complex of europium tris[3-(trifluoromethylhydroxymethylene)-(+)-camphorate] ($\text{Eu}(\text{D-facam})_3$). Drastic emission intensity enhancement (~ 70 times) was achieved in the presence of tetramethylammonium chloride (TMACl). In this report, the detailed interaction of $\text{Eu}(\text{D-facam})_3$ with TMACl is investigated.

Figure 1. shows emission spectra of $\text{Eu}(\text{D-facam})_3/\text{TMACl}$ solutions at various concentration ratio of $[\text{Eu}(\text{D-facam})_3]:[\text{TMACl}]$ upon excitation at 350 nm. The sharp peak of $\text{Eu}(\text{D-facam})_3$ can be observed at 579, 590 and 613nm corresponding to $^5\text{D}_0 \rightarrow ^7\text{F}_0$, $^5\text{D}_0 \rightarrow ^7\text{F}_1$ and $^5\text{D}_0 \rightarrow ^7\text{F}_2$ transitions, respectively. The peak assignable to $^5\text{D}_0 \rightarrow ^7\text{F}_1$ transition splits into two peaks, which suggests the change of the ligand field. The $^5\text{D}_0 \rightarrow ^7\text{F}_2$ transition is known as ‘hypersensitive transition’,² which is much more strongly dependence on the environment than the other transitions. At the ratio of $[\text{Eu}(\text{D-facam})_3]:[\text{TMACl}]=1:10$, the intensity of $^5\text{D}_0 \rightarrow ^7\text{F}_2$ transitions appears surprising enhancement up to 70 times. The symmetry of Eu(III) ion is often estimated by the ratio of emission intensities of $^5\text{D}_0 \rightarrow ^7\text{F}_1/^5\text{D}_0 \rightarrow ^7\text{F}_2$, which is defined as relative intensity (I_{rel}). The decreased I_{rel} indicates the change of coordination structure around the Eu(III) ion, which is also proved by infrared measurement. Besides, we determine the key parameters of energy transfer to evaluate the emission process. The vibrational deactivation was suppressed and high sensitization efficiency from Eu(III) to ligand was achieved.

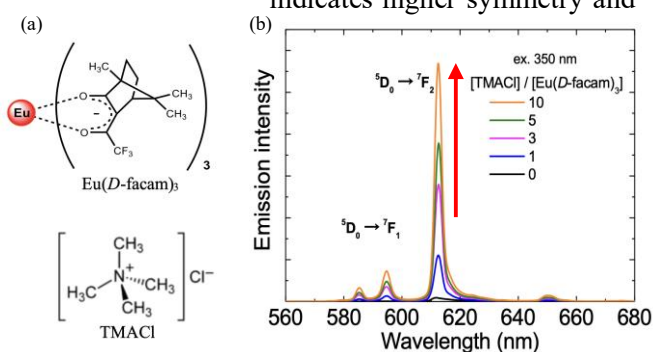


Figure 1. (a) Chemical structures of the $\text{Eu}(\text{D-facam})_3$ and TMACl, (b) emission spectra of $\text{Eu}(\text{D-facam})_3/\text{TMACl}$ solutions at various $[\text{Eu}(\text{D-facam})_3]:[\text{TMACl}]$ ratios upon excitation at 350 nm.

1) Koen Binnemans, *Chem. Rev.*

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