

Photoluminescence of europium(III) tetrakis(thenoyltrifluoroacetate) with imidazolium counteractions in ionic liquids

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The aim of this work was to study the optical properties of a new series of rare earth (RE^{3+}) tetrakis(β -diketonates) complexes with high luminescence intensity, both in solid state and when dissolved in imidazolium-based ionic liquids. The $[\text{C}_n\text{mim}][\text{RE}(\text{TTA})_4]$ (RE : Gd^{3+} e Eu^{3+}) complexes were prepared by using the ligand thenoyltrifluoroacetate (TTA^-) and the counteractions 1-alkyl-3-methylimidazolium ($[\text{C}_n\text{mim}]^+$), varying the length of the alkyl chain at the imidazolium from three to eight carbon atoms. Besides, all the ionic liquids 1-alkyl-3-methyl-imidazolium bromide ($[\text{C}_n\text{mim}]\text{Br}$) were also synthesized. The synthesized complexes had their optical properties studied, both in the solid state and in solutions of the corresponding ionic liquids $[\text{C}_n\text{mim}]\text{Br}$ (Figure 1), using photoluminescence spectroscopy of excitation and emission, time resolved emission spectra, and luminescence decay curves. Based on the phosphorescence spectral data of the complexes $[\text{C}_n\text{mim}][\text{Gd}(\text{TTA})_4]$, it was possible to determine the singlet (S) and triplet (T) excited states positions of the TTA^- ligand in these systems. The $[\text{C}_n\text{mim}][\text{Eu}(\text{TTA})_4]$ complexes showed a high intense red-colored luminescence from the trivalent europium ion, both in the solid state and in solutions of ionic liquids, originating from the ${}^5\text{D}_0 \rightarrow {}^7\text{F}_{0-4}$ transitions. The spectral data of the complexes in each case showed that the transfer of energy from the TTA^- ligand to the Eu^{3+} ion is very efficient. The Eu^{3+} coordination compounds have high emission quantum efficiencies ($\sim 75\%$). This result shows a great potential of these europium systems for application as light-converting molecular devices (LMDCs).

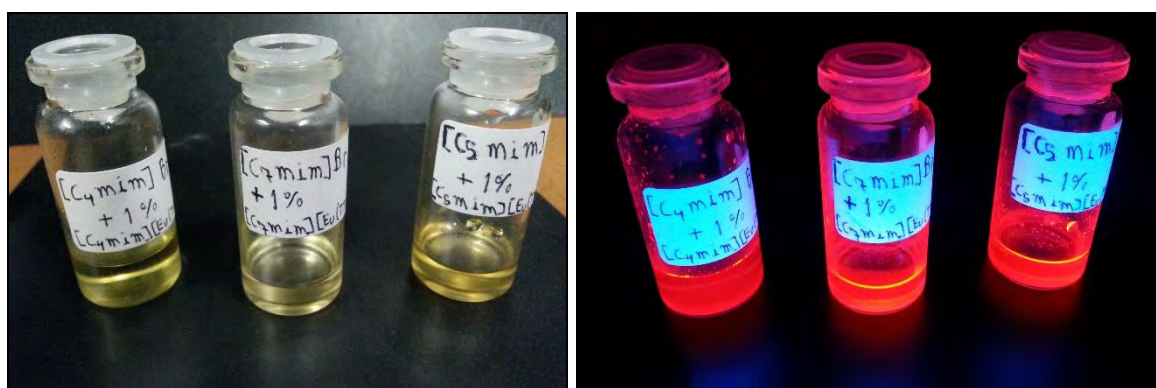


Figure 1. $[\text{C}_n\text{mim}][\text{Eu}(\text{TTA})_4]$ complexes dissolved in $[\text{C}_n\text{mim}]\text{Br}$ ionic liquids, under ambient light (left) and under ultraviolet radiation (right), showing their intense luminescence.

Keywords: rare earths, coordination compounds, imidazolium-based ionic liquids, photoluminescence.

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