Luminescent lanthanide compounds containing novel bis-(β-diketonate) ligands with potential for biological application

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Lanthanide-based coordination compounds (Ln^{3+}) containing β-diketonate ligands are investigated in medicine for diagnostic, therapeutic, and bioassay applications due to their unique luminescent properties. Additionally, ongoing research focuses on developing compounds with extended luminescence lifetimes to minimize background fluorescence [1]. Specifically, the ligand 3,3'-([1,1':2',1''-terphenyl]-4,4''-diyl)bis(1-phenylpropane-1,3-dione) (TBPPD) was synthesized following a literature-reported procedure [2]. The complexes were obtained by direct reaction of three equivalents of the TBPPD ligand with one equivalent of the lanthanide salt. For mixed-ligand complexes, synthesis involved direct interaction of TBPPD with dibenzoylmethane (dbm) and the Ln^{3+} salt in a 1:4:2 ratio [3]. The resulting complexes were characterized using FTIR spectroscopy, CHN elemental analysis, mass spectrometry, NMR, X-ray diffraction, and thermal analysis. The diffuse reflectance spectra of the Eu^{3+} and Gd^{3+} complexes exhibit intense absorption bands in the 200–450 nm range, attributed to the $S_0 \rightarrow S_1$ transition centered on the ligand. In the $[Eu(TBPPD)_3(H_2O)]$ complex, a shoulder appears at longer wavelengths, indicating a reduced contribution from the low-energy ligand-to-metal charge transfer (LMCT) state. This behavior is not observed in $[Eu_2(TBPPD)(dbm)_4(H_2O)_2]$, which is consistent with the higher relative intensity between the ligand-centered absorption band and the 4f–4f transitions.In general, the emission spectrum of this complex exhibits characteristic narrow bands associated with the intraconfigurational transitions of the Ln^{3+} ion. However, for $[Eu(TBPPD)_3(H_2O)]$, the presence of a broad band suggests inefficient intramolecular energy transfer. Systematic studies will further optimize the ligand and complex design to develop an efficient luminescent marker for biological assays.

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