Temperature influence on the emission intensity of a Eu^{3+}/Tb^{3+} bimetallic complex with bipyrimidinic and beta-diketone ligands

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Real-time, non-contact thermal monitoring is crucial in industrial applications where temperature directly affects device functionality. Developing efficient remote sensing technologies can overcome limitations of conventional contact-based methods, such as low spatial resolution [1]. In this sense, this study investigated the temperature-dependent emission behavior of a bimetallic Eu-Tb complex, [TbEu(acac)$_6$-bpm], using acetylacetone (acac) as a sensitizer and 2,2'-bipyrimidine (bpm) as a bridging ligand. The complex was synthesized via a one-pot method (Tb^{3+}:Eu^{3+} = 1:1; acac:bpm = 6:1)[2] and characterized by mass spectrometry (MS), diffuse reflectance (DR), and photoluminescence (PL). MS data confirmed the proposed structure, while the DR spectrum showed a maximum absorption at 263 nm, characteristic of the acac ligand. Emission spectra and time-resolved decay curves were collected over a temperature range of 12 K to 272 K, with intervals of 26 K and a fixed excitation wavelength at the ligand (330 nm). The emission spectra display characteristic Eu^{3+} ($^5D_0 \rightarrow {}^7F_{0\text{-}5}$) and Tb^{3+} ($^5D_4 \rightarrow {}^7F_6$, $^5D_4 \rightarrow {}^7F_5$) transitions, with intensities decreasing as temperature rises due to enhanced non-radiative energy losses, reducing ligand-to-metal sensitization. Notably, the Eu^{3+} spectrum reveals the $^5D_0 \rightarrow {}^7F_5$ transition, which is typically weak or absent in conventional Eu^{3+} emission profiles, suggesting an altered electronic environment in the complex. Emission decay measurements (λ_{ex} = 330 nm; λ_{em} = 702 nm for Eu^{3+}, 540 nm for Tb^{3+}) show a sigmoidal curve profile, with non-linear lifetime reductions of the Eu^{3+} $^5D_0$ and Tb^{3+} $^5D_4$ states, supporting emission trends. These findings highlight the system's potential for thermometric applications, as both emission intensity and lifetime respond to thermal stimuli.

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