

High emission quantum yields and color-tunable properties of Ln-chelates embedded in PMMA

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This research presents a series of PMMA thin layers (labelled **Ln_PMMA**, where Ln = Eu³⁺, Tb³⁺, Sm³⁺, Dy³⁺) with high overall emission quantum yields of $Q^L_{Eu} = 85\%$, $Q^L_{Tb} = 66\%$, $Q^L_{Sm} = 3\%$, and $Q^L_{Dy} = 6\%$ with introduced lanthanide (Ln³⁺) coordination compounds of the type [N₂LnL₄(OTf)(DMF)] (where L = N-(diphenylphosphoryl)-pyrazine-2-carboxamide, OTf = [CF₃SO₃]⁻, DMF = N,N-dimethylformamide). This is the first analysis comparing the photophysical properties of coordination compounds encapsulated in PMMA with single crystals, which includes the influence of factors such as the inhomogeneity of the Ln³⁺ coordination polyhedra and the refractive index. A model is proposed to estimate the change in Q^L_{Ln} when the Ln chelate is incorporated into a PMMA medium, and it satisfactorily reproduces the experimental data with a maximum absolute error of 3% for the case of Eu³⁺ samples. At the same time, our work shows the influence of the PMMA matrix on the photophysical properties of Ln³⁺ with large (Eu, Tb) and small energy gaps (Sm, Dy) between the emitting levels and adjacent levels with lower energy. Q^L_{Ln} for coordination compounds introduced into PMMA decreases relative to single crystals by about 10% for Eu³⁺ and Tb³⁺ as well as by about 70% for Sm³⁺ and Dy³⁺ for which emitting levels are quenched by the electron-phonon coupling presented by the vibrational modes of the PMMA matrix. **Ln_PMMA** thin layers containing a mixture of Eu³⁺, Tb³⁺, Sm³⁺ and Dy³⁺ coordination compounds are characterized by multicolor tunable emission.

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