

CHARACTERIZATION OF THE LUMINOPHORE COMPOUNDS BASED ON Eu^{3+} IONS COORDINATED WITH DIFFERENT LIGANDS

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Organic materials on Eu^{3+} ions base are excellent materials for a new generation of light emitting devices with high efficiency, and wide potential applications as luminescent labels in biological systems, etc. Organic compounds (OC) $\text{Eu}(\text{TTA})_3\text{H}_2\text{O}$, $\text{Eu}(\text{TTA})_3\text{Phen}$, $\text{Eu}(\text{DBM})_3\text{Phen}$, $\text{Eu}(\text{TTA})_3(\text{Ph}_3\text{PO})_2$, $\text{Eu}(\text{TTA})_2(\text{Ph}_3\text{PO})_2\text{NO}_3$, $\text{Eu}(\text{o-MBA})_3\text{Phen}$ coordinated with active acceptor (TTA, DBM and o-MBA) and neutral (H_2O , Phen, Ph_3PO , and NO_3) ligands were obtained by chemical methods. OC have been characterized by optical transmission and photoluminescence (PL) measurements at different concentrations.

The absorption thresholds at different concentrations of OCs in solutions were approximately the same (3.34 – 3.4 eV). Photoluminescence spectra were measured using monochromator based on MDR-23-24 connected to the PC, photoluminescence excitation was performed with nitrogen laser ($\lambda = 337 \text{ nm}$) radiation intensity range $0.1\text{--}10^3 \text{ W/cm}^2$. All types of OC show similar characteristics of photoluminescence. PL spectra characterized the efficiency of energy transfer from the LUMO energy levels of ligands of the compound to the 4f energetic levels of Eu^{3+} ion. The PL levels of the complexes OC are found to be situated between levels S and T of ligands. The 5 bands of PL centred at 580, 590, 612 - 615, 651, and 700 nm, have been attributed to the radiative transitions of the Europium 4f - 4f transitions ${}^5\text{D}_0 \rightarrow {}^7\text{F}_i$ ($i = 0, 1, 2, 3$ and 4), respectively. This has been explained from the viewpoint of the surrounding environment of Eu^{3+} ion and removal of internal interdiction for transitions in electronic 4f shield of Eu^{3+} ion as a result of ligands interactions.

Based on selection rules of transition the band at 594 nm is attributed to the ${}^5\text{D}_0 \rightarrow {}^7\text{F}_0$ parity-allowed magnetic dipole transition, which is independent of the surroundings symmetry. The dominant maxima of PL are situated in the range 612-615 nm with halfwidth less than 10 nm and its intensity is about 20 times higher than the intensity maxima of other bands. The ${}^5\text{D}_0 \rightarrow {}^7\text{F}_{1,2}$ transitions are allowed as electrical-dipole transitions. All ${}^5\text{D}_0 \rightarrow {}^7\text{F}_i$ transitions have hyper-sensitive to the symmetry of the crystal field surrounding the Eu^{3+} ions and its FL bands are divided in a few maxima. For obtain the parameters (relaxation time, efficiency and surface capture) from absorption and photoluminescence spectra of 4f transitions of Eu^{3+} ions it was applied the Jud-Ofelt model.

The luminescence of all organic compounds exhibited an impressive brightness and independent spectral stability with a main emission peak in domain 612 - 615 nm. To the best of our knowledge, this luminescence with TTA and TOPO ligands have the brightest emission among OCs complexes. These properties demonstrate that the chelate OCs with TTA and triphenylphosphine oxide ligands can form the rigid and compact complex structure, increase the efficiency of OCs, and reduce the ability of the exciplex formation.

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