

CHARACTERIZATION OF THE DISSOLUTION OF FUNCTIONAL ORGANIC COMPOUNDS ON EUROPIUM BASE

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Organic compounds (OC) Eu(TTA)₃H₂O, Eu(TTA)₃Phen, Eu(DBM)₃Phen, Eu(TTA)₃(Ph₃PO)₂, Eu(TTA)₂(Ph₃PO)₂NO₃, Eu(o-MBA)₃Phen coordinated with active acceptor (TTA, DBM and o-MBA) and neutral (H₂O, Phen, Ph₃PO, and NO₃) ligands were obtained by chemical methods. This class of ligands is known for its biological application [1,2] and are widely used as analytical sensors, luminescent markers in immunoassays, etc. The solutions of RE OC have been characterized by optical transmission and photoluminescence (PL) measurements at different concentrations. Physical properties of the solutions were measured in polar and nonpolar solvents (water, alcohol ethyl, dimethylformamide, acetone, toluene, etc.) in order to evaluate its possible applications in the biological effects of rare earth-containing functional materials.

The absorption thresholds of solutions at different concentrations of RE OCs were approximately the same (3.34 – 3.4 eV). Photoluminescence spectra were measured using MDR-23-24 monochromators connected to the PC, photoluminescence excitation was performed with lasers ($\lambda = 337$ and 405 nm). All types of the solutions of RE OC show similar characteristics of photoluminescence. PL spectra are characterized with the efficiency of energy transfer from the LUMO energy levels of ligands of RE compound to the 4f energetic levels of Eu³⁺ ion. An impressive brightness and independent spectral stability there are with a main emission peak in domain 612 - 615 nm. The 5 bands of PL maxima centered at 580, 590, 612 - 615, 651, and 700 nm are found and they have been attributed to the radiative transitions of the Europium 4f - 4f orbital $^5D_0 \rightarrow ^7F_i$ ($i = 0, 1, 2, 3$ and 4), respectively. This has been explained from the viewpoint of the surrounding environment of Eu³⁺ ion and removal of internal interdiction for transitions in electronic 4f shield of Eu³⁺ ion as a result of ligands interactions. Based on selection rules of transition the band at 594 nm is attributed to the $^5D_0 \rightarrow ^7F_0$ parity-allowed magnetic component of the dipole transitions, which is independent of the surrounding 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 $^5D_0 \rightarrow ^7F_{1,2}$ transitions are allowed as electrical component of dipole transitions. To obtain the parameters (relaxation time, efficiency and surface capture) from absorption and photoluminescence spectra of 4f transitions of Eu³⁺ ions it was applied the Judd-Ofelt model. For assessment, the best luminescence RE OCs are for organic compounds with TTA and TOPO ligands which have the brightest emission. RE OCs chelated with ligands 1,10 tenoyltrifluoroacetate (TTA) and triphenylphosphine oxide (TOPO) have formed a complex with the rigid structures and compact solutions, which result in the increasing of luminescence efficiency and reduction ability of the exciplex formation. Because of choice of nontoxic and biocompatible solvents RE OCs systems have a great potential for various biological applications.

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