

Europium and terbium ortho-, meta-, and para-methoxybenzoates: structural peculiarities, luminescence, and energy transfer.

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Streszczenie

A series of methoxybenzoates $\text{Ln}(\text{MOBA})_3 \cdot n\text{H}_2\text{O}$ and $\text{Ln}(\text{MOBA})_3 \cdot \text{L}$ ($\text{Ln} = \text{Eu}, \text{Gd}, \text{Tb}$; MOBA – 2-, 3-, and 4-methoxybenzoate anions, L – 1,10-phenanthroline (Phen) and 2,2'-bipyridine (Bpy)) was investigated by methods of optical spectroscopy. The effects of methoxy groups located in different positions of the benzene ring on the structure of Eu^{3+} luminescence centers, the lifetimes of $^5\text{D}_0$ (Eu^{3+}) and $^5\text{D}_4$ (Tb^{3+}) states, the energies of the lowest singlet and triplet states of the ligands, and on processes of the excitation energy transfer to Eu^{3+} and Tb^{3+} ions are examined. The spectroscopic data for lanthanide methoxybenzoates are in accordance with known structural peculiarities: the lanthanide–oxygen bond lengths and the Ln^{3+} coordination polyhedron distortions. The low-energy ligand–metal charge transfer state was identified in the compound $\text{Eu}(\text{4-MOBA})_3$. It was shown that the distortions of Ln^{3+} luminescence centers are the smallest for 2-methoxybenzoates. The enhancement of Tb^{3+} luminescence efficiency by 2–2.5 times for terbium methoxybenzoates with phenanthroline $\text{Tb}(\text{MOBA})_3 \cdot \text{Phen}$ in comparison with benzoate $\text{Tb}(\text{Benz})_3 \cdot \text{Phen}$ at 295 K is caused by a decrease in the rate of back energy transfer due to an increase in the energy of the lowest Phen triplet state. The highest luminescence efficiency was observed for $\text{Tb}(\text{4-MOBA})_3 \cdot \text{Phen}$. Judging from the results presented, the $\text{Tb}(\text{4-MOBA})_3 \cdot \text{Phen}$ can be potentially more preferable for the fabrication of emitter layers in organic light emitting diodes (OLEDs) than the $\text{Tb}(\text{2-MOBA})_3 \cdot \text{Phen} \cdot \text{H}_2\text{O}$, which has been tested before.

Słowa kluczowe

Eu^{3+} , Tb^{3+} , Methoxybenzoate, atom, 10-Phenanthroline, molecule, 2'-Bipyridine, luminescence, Lifetime, Triplet state, Back energy transfer, X-ray crystal structure

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