Intramolecular energy transfer and its influence on the overall quantum yields of Eu^{3+} and Tb^{3+} chelates with dimethyl(phenylsulfonyl)amidophosphate ligands

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Streszczenie

Lanthanide chelates with dimethyl(phenylsulfonyl)amidophosphate (labeled as HSP) and Lewis base ligands (bpy = 2,2;-bipyridine and phen = 1,10-phenanthroline) of formula $Na[Ln(SP)_4]$ (**1Ln**), $[Ln(SP)_3bpy]$ (**2Ln**); $[Ln(SP)_3phen]$ (**3Ln**) (Ln = Eu^{3+}, Gd^{3+}, Tb^{3+} and Lu^{3+}) were obtained and characterized by the X-ray, photoluminescence spectroscopy at 293 and 77 K as well as by intrinsic (�LnLn) and overall (�Ln�) luminescence quantum yields. These phosphors manifest a very strong emission after excitation in the UV range of the molecular singlet states (S_1) and two of them have very high �Ln� values (Eu^{3+} and Tb^{3+} chelates of the type **2Ln** and **3Ln**). The dynamics of the excited states are discussed based on the intramolecular energy transfer theory, considering the dipole–dipole, the dipole-multipole and the exchange mechanisms. From the calculated energy transfer rates, a rate equation model was constructed and, thus, the theoretical �Ln� can be obtained. A good correlation between the experimentally determined and theoretically calculated �Ln� values was achieved, with the triplet state (T_1) playing a predominant role in the energy transfer process for Eu^{3+} compounds, while the sensitization for Tb^{3+} compounds is dominated by the energy transfer rates from the singlet state (S_1).

Słowa kluczowe

sulfonylamidophosphates, luminescence, energy transfer rates, quantum yields, theoretical calculations

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