

Enhanced luminescent properties of europium complex by replacement of water molecules by 2, 2'-Bipyridine

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The luminescent properties of different host lattices doped with rare-earth ions have been extensively investigated for several years. The structural tuning of lanthanide complexes as efficient light-conversion devices has become an important pursuit to researchers due to their excellent luminescence properties. The excellent luminescence of organic-metal complexes is due to energy transfer from organic ligand to central metal ion by "antenna effect", which can increase the luminescence efficiency. The β -diketones are excellent organic molecules to transfer energy to lanthanide ions [1, 5]. The europium complexes mainly involve five narrow emission lines, corresponding to $^5D_0 \rightarrow ^7F_j$ transitions, where $j = 0, 1, 2, 3$ and 4 emitting at $\sim 580, \sim 590, \sim 610, \sim 650$ and ~ 700 nm respectively, $^5D_0 \rightarrow ^7F_2$ being the strongest with red emission of high color purity [6, 7]. In recent years organic electroluminescent materials have been prepared representing a low cost fabrication route and low voltage operation for large area light display technology and large flat panel display.

In present work the complex $[\text{Eu}(\text{L})_3(\text{bipy})]$ (Where L = 2'-hydroxy-4'-methoxyacetophenone, bipy = 2, 2'-Bipyridine) was synthesized and characterized by elemental analysis, energy dispersive X-ray spectroscopy, ^1H NMR spectroscopy, infra red spectroscopy, TGA/DTA, scanning electron microscopy and the excitation as well as emission spectrum. The complex emitting red luminescent might be used to make the electroluminescent devices.

The complex was found to be soluble in dimethylsulfoxide, dimethylformamide, chloroform, dichloromethane and acetone, sparingly soluble in methanol, ethanol and ethyl acetate but insoluble in benzene, hexane and toluene. Elemental analytical data for the complex C % found = 55.12 (calc. = 55.29), N % found = 3.41 (calc. = 3.49) and H % found = 4.61 (calc. = 4.36) indicated that the stoichiometry of the complex to be 1: 3: 1 (Eu : L: bipy). Values for various ^1H NMR chemical shifts for $[\text{Eu}(\text{L})_3(\text{bipy})]$ are: 2.70 (s, 9H, 3 $-\text{OCH}_3$), 3.9 (s, 9H, 3 $-\text{CH}_3$), 7.05 (m, 6H, Aromatic), 7.79-7.86 (m, 6H, Aromatic), 7.90 (bs, 3H, Aromatic), 10.35 (d, 2H, Aromatic). Abbreviations used to describe the spectrum are: s = singlet, d = doublet, t = triplet and m = multiplet. All chemical shifts are given in ppm with respect to tetramethylsilane (TMS). The infra-red studies showed the characteristic stretching peak at 1638 cm^{-1} due to C = O group of the free L shifted to 1612 cm^{-1} in the complex, indicated that the C = O group of the L participated in coordination with Eu^{+3} ions. The peak for Ph—O vibration (Ph = phenyl) at 1255 cm^{-1} in free L shifted to 1241 cm^{-1} in the complex which indicate that the Ph—O group coordinated with Eu^{+3} ions. C—N vibration mode of bipy appeared at 1498 and 1410 cm^{-1} shifted to 1474 and 1388 cm^{-1} in complex as well as the benzene ring C—H

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bending vibration peaks of bipy in high frequency region appearing at 864 and 739 cm^{-1} are shifted to 841 and 724 cm^{-1} , indicating that the chemical bonds are formed between Eu^{+3} ions and nitrogen atoms of bipy. The bands 1417 cm^{-1} and 1452 cm^{-1} , 1517 cm^{-1} were assigned to C—C skeletal vibrational stretching of aromatic ring. Finally, the absorption peak at about 431 cm^{-1} in complex can be assigned to the Eu—O vibration absorption band. Overall, the results indicated that bipy coordinated with the Eu^{+3} ions through nitrogen while L coordinated with the Eu^{+3} ions through oxygen atoms of C = O group and phenolic group. The TGA/DTA curves of the complex show weight loss at about 320°C is due to elimination of bipy and the weight loss at about 510°C is due to elimination or decomposition of L. However, above 510°C the complex $[\text{Eu}(\text{L})_3(\text{bipy})]$ completely get decomposed to form Eu_2O_3 as residue. The scanning electron micrographs for the complex showed that the material obtained had regular shaped particles with size less than $1\mu\text{m}$ without any phase separations. The complex may facilitate the future applications with good optical properties. The emission spectrum of complex is shown in Fig. 1 was recorded at room temperature taking $\lambda_{\text{ex}} = 384\text{ nm}$.

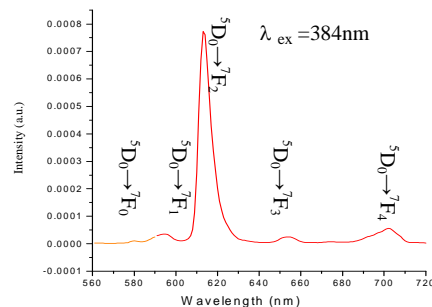


Fig. 1 Emission spectrum of $[\text{Eu}(\text{L})_3(\text{bipy})]$

The emission spectrum of $[\text{Eu}(\text{L})_3(\text{bipy})]$ consists of five peaks at 582 nm ($^5D_0 \rightarrow ^7F_0$), 590 nm ($^5D_0 \rightarrow ^7F_1$), 612 nm ($^5D_0 \rightarrow ^7F_2$), 650 nm ($^5D_0 \rightarrow ^7F_3$) and 704 nm ($^5D_0 \rightarrow ^7F_4$). Among these, the emission at 612 nm from the ($^5D_0 \rightarrow ^7F_2$) electronic transition is the strongest. The present europium complex has high photoluminescent intensity (64.82 cd/m^2) might be used to make the electroluminescent devices.

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