



EFFECT OF TRIVALENT LANTHANIDES ON THE PHOTOLUMINESCENCE OF ALUMINIUM SALICYLATE COMPLEX

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Abstract- This paper describes the simple synthesis of Aluminium salicylate and the effect of trivalent rare earth ions viz La³⁺ Y³⁺ on the luminescence of Al-salicylate. It is observed that the excitation of Al-salicylate which is normally observed around 330nm gets shifted to 350 nm when doped with either of La or Y. The emission of Al-salicylate also changes and the main band is observed around 450 nm instead of 430 nm. The lower band gets shifted to lower side and is observed around 360 nm instead of 400nm. This study will be useful in developing organic phosphors for various applications.

Keywords- Photoluminescence, Organic Phosphors, salicylate complex

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Introduction

Investigation on molecular coordination complexes of lanthanide ions has been attracted significant attention, owing to their fluorescent broad applications in biochemistry, material chemistry, medicine and so forth [1]. The main features of the absorption–energy transfer–emission process are a large Stokes shift, a narrowband emission which is specific of the lanthanide and a long fluorescence lifetime. Rahmiye aydin and other researchers have report the binary and mixed ligand complexes of Y(III) and their equilibrium between Y(III) and the title ligands were reported [2-5]. It is well established that yttrium is always found in nature with lanthanides, and its ionic radius is 1.04 Å^o for coordination number 61 and its chemical properties are very similar to the later lanthanides (1.00-1.17 Å^o). Some of the trivalent lanthanide ions exhibit excellent luminescence characteristics when the native luminescence is enhanced by coordination with suitable organic ligands .It is essential to design appropriate ligands to optimize the luminescence properties of lanthanide ions by facilitating the well-known light conversion process, which show to be efficient ligand-to-metal energy transfer process [6]. The enhancement of luminescence intensity by complexation of the tripositive luminescent lanthanide, Ln(III), ions has been explained on the basis of a

ligand-to-metal energy transfer mechanism [7] . This mechanism for energy transfer was derived from a systematic series of investigations by Kasha and Crosby and their coworkers. It states that, when a coordinating ligand excited triplet state overlaps a lanthanide excited electronic level, the lanthanide luminescence is effectively pumped by the large cross-section molecular absorbance of the ligand rather than by the weak lanthanide absorbance. This process can be more efficient than direct absorption of light by the lanthanide, since the lanthanides exhibit low molar absorptivities [8]. Lanthanum and yttrium ions should perform similarly if the transfer of energy is facilitated through the coordinating ligands, since neither of these ions has any occupied f orbitals to produce an energy sink. The enhanced performance of Y(III) is believed to be due to a higher purity. The similarities of the lanthanide ions results in difficulties as Y(III) is likely to have lanthanide impurities that could act as additional energy sinks. This theory is supported by a study showing that, when lanthanum is obtained in a purity of 99.999% or better, its enhancement can equal that of yttrium. [8] Yttrium is always found in nature with rare earths and its chemical properties are very similar to lanthanum. Most of the chemistry of yttrium has been investigated in connection with studies on the rare earths [9-14].

Experimental

Complex of Al^{3+} ions with salicylate is prepared in the following way. Dissolve the corresponding salt mostly nitrate in the desired amount in distill water. Dissolve salicylic acid in alcohol. Mixed the two solutions and add NaOH solution to make the solution basic. For doping Y of La dissolve pure Y_2O_3/La_2O_3 in desired amount in nitric acid and make alcoholic solution. Add this solution to Aluminium nitrate solution and then add salicylic acid solution along with NaOH solution to get Y/La doped Al-salicylate. Precipitate is obtained which was then filtered with the help of filter paper. The filtrate was dried under the lamp for several hours to drive away the moisture and used for photoluminescence measurements. Photoluminescence measurements were made on Hitachi 4000 spectrophotometer.

Results and Discussion

Figure. 1 shows the photoluminescence spectra of various Al-Y salicylate. Intense Broad band emission is observed with a peak at 450 nm (Fig. 1(b)) with the second band around 370 nm. Emission band has a shoulder at 441nm, 420nm and 400nm. The excitation spectra are observed at 350nm (Fig. 1a). Similar excitation (Fig. 2b) and emission (Fig. 2a) peaks are observed for Al-LaSalicylate but intensity is greater than Al-Y Salicylate. The pure Al-salicylate shows double band emission with peaks around 400 nm and 430 nm. The excitation to this emission is observed around 330 nm. Thus the shift of almost 20 nm is observed when trivalent Y/La is doped in Al-Salicylate. From the above observations it is clear that emission and excitation can be tailored by doping of trivalent Y/La ions. This study will be useful in developing salicylate based organic phosphors.

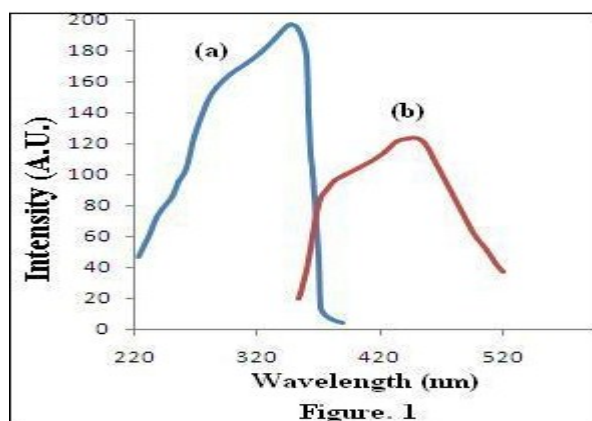


Figure. 1

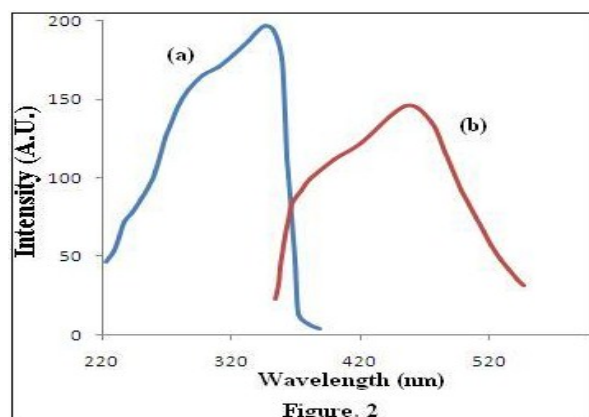


Figure. 2

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