**Report of Ph.D. Thesis**

**Photoluminescence, 4f−4f Absorption and NMR Studies of Ternary Lanthanide Enolates**

Name of Ph.D. Scholar: **Asgar Ali**

Department of Chemistry, Faculty of Sciences, Jamia Millia Islamia, New Delhi 110025

The thesis presents an account of the work carried out by Mr. Asgar Ali at the Department of Chemistry. F/O Sciences, Jamia Millia Islamia, New Delhi 110025.

The Ph.D. thesis consists of five chapters. The **first chapter** deals with brief introduction about lanthanides and β-diketone and covers a brief literature overview of lanthanide trivalent complexes focusing on recent publications with proper citations of relevant literature. This chapter also thoroughly discusses NMR with proper citations. **Chapter II** deals with design and synthesis of Eu(III) complexes. The candidate reported four europium(III) complexes with different ancillary ligands and were fully characterized by NMR, FTIR, Single crystal XRD and elemental analysis. The geometry of the complexes was determined using SHAPE software. The photoluminescence properties of the four complexes were studied in solid, solution and in PMMA based thin films. The results suggested that these complexes have excellent luminescent properties suggesting potential applications in OLEDs. Moreover, the absolute quantum yields of the complexes in solid state were obtained and compared with literature values. The band gap of the complexes was also determined from absorption spectra using Tauc’s equation.

The **chapter III** describes the design, synthesis, and photoluminescence studies of four samarium complexes. The complexes were synthesized by reacting samarium chelate with four different ancillary ligands. These complexes were thoroughly characterized by NMR, FTIR spectra and elemental analysis. Moreover, crystal structure of complex **2** and **4** were also obtained and their shape were determined using SHAPE software. The photoluminescence properties of these complexes were investigated in both visible and in near infrared regions and these complexes shows good luminescence, indicating effective energy transfer from ligand to metal ion. The absolute PLQY of the complexes were determined in solid state and these complexes show good quantum yield. This chapter also deals with the temperature dependent photoluminescence of the complex **2** and it has been reported that this complex could have potential application as temperature sensing in range of 60 K to 350 K.

In **Chapter IV**, four terbium based complexes were synthesized using different ancillary ligands and well characterized. Single X-ray crystallography of complex **1** and **2** was analyzed to elucidate their molecular structure. The photoluminescence properties of these complexes were further investigated in different phases. The photoluminescence studies showed that efficient energy transfer takes place from ligands to metal center. The optical band gap of these complexes was determined and showed that these values lie in semiconductor region.

In **Chapter V**, four neodymium based complexes were synthesized using different ancillary ligands and thoroughly characterized. Single X-ray crystallography of complex **2** was also analyzed to elucidate their molecular structure. The photoluminescence properties of these complexes were investigated in near infra-red region. These complexes show excellent luminescence indicating efficient energy transfer from ligand to metal center. Moreover, the oscillator strength and effect of solvents on the band shape of the 4f-4f absorption were investigated and discussed. The change in the band shape was correlated with asymmetry of the complexes.

Overall, I feel that this thesis presents an exhaustive study of lanthanide based luminescent complexes and nicely presented. The candidate has already published two research papers in peer reviewed international journal ‘Dalton Transactions’. Appropriate conclusions and discussion are included. Therefore, the research work has already found its acceptability by the National and International scientific community.

In view of these observations, I strongly recommend that the thesis be accepted for award of Ph.D. degree by Jamia Millia Islamia on satisfactory performance in Viva-voice examination.

Dr. Rahisuddin

Associate Professor

Department of Chemistry

Jamia Millia Islamia

New Delhi 110025