Preface

The key motivation of this thesis work is to synthesize and study the luminescence properties of the rare-earth doped $SrMoO_4$ and rare-earth-free $Zn_3(VO_4)_2$ phosphors for diverse applications such as white light emitting diode, color-tunable devices, and optical thermometry. The $SrMoO_4$ and $Zn_3(VO_4)_2$ phosphors have been used as a host matrix for the preparation of red and greenish-blue emitting phosphors owing to their application-friendly properties such as excellent thermal and chemical stability, low cost and environment-friendly synthesis, near-UV absorption, and good solubility for rare-earth elements.

The research work presented in this thesis has been divided into **eight** chapters.

Chapter 1 presents a brief introduction to the luminescence phenomenon, phosphor materials, and properties of the rare-earth elements. This chapter discusses the limitations and challenges of the phosphors used in the commercial wLED, tunable light sources, and optical thermometry applications. The challenges and limitations of these applications which leads to the exploration of new doped phosphors have also been discussed in this chapter. This chapter also includes a focused study on the structural and luminescence properties of the $SrMoO_4$ and $Zn_3(VO_4)_2$ phosphors used in the thesis work. Based on the study of various phosphors used in different optoelectronic applications, the motivation behind the thesis work has been outlined at the end of this chapter.

Chapter 2 deals with probed experimental and analysis techniques that have been used for sample synthesis and studying the various structural and luminescence properties of the prepared composition.

Chapter 3 presents the study of pure $SrMoO_4$, Sm^{3+} (1% – 5%) doped $SrMoO_4$ and Bi^{3+} (1% – 3%) co-doped in 4% Sm^{3+} doped $SrMoO_4$ ($SrMoO_4$:$4Sm^{3+}$) phosphor synthesized solution combustion method. The structural analysis has been carried out for crystal structure, phase identification, and calculation of crystallite size and microstrain. Some results from the absorption spectra such as red-shift in the doped and co-doped samples have been discussed. The effects of Bi^{3+} co-doping on the reddish-orange emission of Sm^{3+} doped $SrMoO_4$ has been discussed in this chapter. The reduced microstrain and increased crystallinity of the phosphors as a result of Bi^{3+} co-doping and their correlation with the luminescence of Sm^{3+} ions are discussed.

Chapter 4 describes the result of Zn^{2+} co-doping on the photoluminescence and structural properties of Sm^{3+} doped $SrMoO_4$ phosphors. The structural and elemental properties were investigated by XRD, FTIR, and XPS analysis. The chapter also presents the morphological study of the phosphors and an augmentation in the particle size after Zn^{2+} doping has been discussed. Photoluminescence excitation and emission analysis evince the improvement in the intensity after 1% Zn^{2+} co-doping in the 4% Sm^{3+} doped $SrMoO_4$ phosphor. Moreover, the temperature-dependent PL study is discussed which reveals good thermal stability of the phosphor. The near-UV excitation and reddish-orange emission of the prepared Zn^{2+} co-doped SrMoO4:$4Sm^{3+}$ phosphor shows that it can be a potential red phosphor for lighting devices.

Chapter 5 deals with the study of energy transfer dynamics, emission color tuning, and fluorescence thermometry in Dy^{3+}/Eu^{3+} co-doped $SrMoO_4$ phosphors. The chapter demonstrates a viable scheme for tailoring the PL emission of single-phase phosphors through precisely controlling dopant concentrations and by modulating excitation wavelength. We have reported that the emission is tuned from greenish-yellow to white and greenish-yellow to reddish-orange. A detailed energy transfer process from the host to the Ln^{3+} ions and between the Ln^{3+} ions is discussed. The fluorescence thermometry is studied by examining the fluorescence intensity ratio of Dy^{3+} and Eu^{3+} PL intensities under 297 nm. Furthermore, the configurational coordinate diagram is presented to elucidate the nature of temperature-dependent PL emissions. Therefore, this chapter shows that our research opens up new avenues for the development of color-tunable luminous materials for various optoelectronic and temperature sensing applications.

Chapter 6 presents the photoluminescence properties of rare-earth free $Zn_{(3-x)}Bi_x(VO_4)_2$ (x=0, 0.01, 0.03, 0.05) phosphors, synthesized by solution combustion method. The structural and elemental properties were investigated by XRD and FTIR analysis. The absorption and photoluminescence properties infer that the samples have a broad near UV absorption and greenish-yellow emission. The host has broadband emission is enhanced by the factor of 11 after 1% doping of Bi^{3+} ions.

Chapter 7 present synthesis and spectral study of $Zn_{(3-x)}Li_x(VO_4)_2$ (x=0, 0.01, 0.02, 0.03) samples. The structural and elemental properties were investigated by XRD, FTIR, and XPS analysis. The Li^+ ion doping enhances the broadband excitation in the near UV region and emission band of $Zn_3(VO_4)_2$ in the visible region with Stokes shift of 9517.3 cm^{-1}. A discussion on the reasons for improved PL after Li^+ doping is also discussed. The thermal stability of the phosphor is checked by studying the temperature-dependent PL spectra.

Conclusions of overall studies have been summarized in the last **chapter 8**. This Chapter also comprises further future research plans on this topic.