Preface

The major motivation for my thesis work came from the study of rare-earth doped phosphors for various applications such as white light-emitting diodes (wLEDs), monochromatic phosphors used in display devices, and other applications based on their luminescence properties. $CaMoO_4$ phosphors have been doped with various rare-earth elements to produce excellent red, green and near-white emitting phosphors that are readily transferable to the host lattice matrix. $CaMoO_4$ represents a better host for luminescence-based applications because of its properties such as eco-friendly and low-cost synthesis, excellent thermal and chemical stability, good solubility for rare-earth elements, and near-UV absorption.

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

Chapter 1 gives a brief overview of the phenomena of luminescence, its types, photoluminescence mechanism, phosphor materials, and the characteristics of rare-earth elements. The limits and difficulties of phosphors used in industrial wLED and its dependent parameters are covered in this chapter. The structural and luminescent characteristics of the $CaMoO_4$ phosphor employed in the thesis work are also specifically examined in this chapter. At the end of this chapter, the thesis's rationale is described. It is based on research on numerous phosphors utilized in various optoelectronic applications.

Chapter 2 discusses the synthesis methods used for the preparation of phosphors and the analytical techniques used for the structural and luminescent properties of phosphors, the study of which explains the various structural and luminescence properties of phosphors in subsequent chapters.

Chapter 3 shows the enhancement of the luminescence of $CaMoO_4$:4Eu^{3+} red phosphors with doping of limited concentrations of the transition ion Mn^{2+} ions. In this chapter, pure

$CaMoO_4$, Eu^{3+} (2% to 5%) doped $CaMoO_4$, and Mn^{2+} (0.1%, 0.3%, and 0.5%) co-doped 4% Eu^{3+} doped $CaMoO_4$ phosphors were synthesized by urea assisted combustion method. Structural analysis has been studied for crystal structure, phase identification, and calculation of crystallite size and microstrain. Some results of absorption spectra such as red-shift in doped and co-doped samples are discussed. This chapter discusses the effects of Mn^{2+} co-doping on the red-orange emission of Eu^{3+}-doped $CaMoO_4$. The correlation of the changed crystal field with Mn^{2+} co-doping and the luminescence of Eu^{3+} ions is discussed.

Chapter 4 describes the role of Bi^{3+} ions in the green luminescence of $CaMoO_4$:5%Tb^{3+} phosphors. $CaMoO_4$, Tb^{3+} (2% to 6%) doped $CaMoO_4$ and Bi^{3+} (2% to 5%) co-doped 5% Tb^{3+} doped $CaMoO_4$ samples prepared by urea-assisted combustion synthesis method. Structural and morphological analysis of all the samples has been studied and their crystalline phase, lattice strain, crystalline size and particle size have been discussed. In this chapter, the improvement in crystallinity due to doping of Bi^{3+} ions is explained and correlated with the luminescence of $CaMoO_4$:5%Tb^{3+} green phosphor. This chapter discusses the charge transfer between the energy levels of Bi^{3+} ion to Tb^{3+} ion. Moreover, the thermal stability of the best Bi^{3+} co-doped phosphor has also been investigated.

Chapter 5 discusses the study of energy transfer dynamics in Sm^{3+}/Dy^{3+} co-doped $CaMoO_4$ phosphors for single-component white light emitters. The chapter deals with the conversion of cold white light to neutral white light by precisely controlling the Sm^{3+} dopant concentration, which is a major drawback for commercial wLEDs. The chapter deals with the study of crystalline structure, particle shape and size through structural and morphological analysis. The energy transfer process between Dy^{3+} ions and Sm^{3+} ions from the host as well as from Dy^{3+} ion to Sm^{3+} ion is discussed. In the PL decay lifetime section of this chapter, the energy transfer between Dy^{3+} to Sm^{3+} is explained in detail and the energy transfer efficiency is also determined.

Chapter 6 presents the enhancement of the photoluminescence properties of Dy^{3+} doped $CaMoO_4$ phosphors with co-doping of Zn^{2+} ions. The chapter presents the structural and elemental properties investigated by XRD, SEM, TEM, FTIR and XPS. The Zn^{2+} co-doping improves the crystallinity of the $CaMoO_4$:4%Dy^{3+} phosphor by reducing the defect levels which is explained in detail in the XPS section. The chapter shows the correlation between the change in crystallinity and the improvement in luminescence by Zn^{2+} co-doping. Moreover, the thermal stability of 0.25% Zn^{2+} co-doped $CaMoO_4$:4%Dy^{3+} phosphor has also been investigated. Therefore, this chapter opens new avenues for development as excellent single-component white light emitters for various optoelectronic applications.

Chapter 7 discusses a brief description of the thesis and presents a further plan for further studies including improving the work presented in the thesis and studying it with other applications.