8.1 Summary and Conclusions

The thesis work mainly deals with the investigation of structural, optical, magnetic and electrical properties of undoped and rare earth doped Sr_2SnO_4. For the present study, all samples were prepared in single phase by solid state ceramic route. Different experiments were carried out and results were carefully analyzed to monitor the changes in the structure, optical, magnetic and electrical properties of undoped and rare earth doped Sr_2SnO_4. This chapter presents a concise summary based on the results of the previous chapters and the discussions.

1. Thermogravimetric analysis (TGA) & Differential scanning calorimetry (DSC) studies combined with X-ray diffraction (XRD) technique confirmed that the single phase powder of Sr_2SnO_4 (using raw materials $SrCO_3$ and SnO_2) can be obtained by calcination at 1000^{o}C for 8 h.
2. Rietveld refinement of XRD data has confirmed that all the samples synthesized in this work have tetragonal crystal and space group ($I4/mmm$).
3. Raman and Fourier transform infrared (FTIR) spectroscopy studies indicated that all samples are single phase material and dopants have been incorporated at targeted sites.
4. The UV-Vis spectroscopy studies of the samples suggested that direct band of Sr_2SnO_4 is 4.74 eV whereas, indirect band gap is 4.00 eV. Increase/decrease in the value of band gap has been observed depending on the nature of the dopant.
5. Transmission electron microscopy studies revealed that particles shape is spherical and average particle size lies between (45.12 - 76.00) nm.
6. The Field Emission Scanning Electron Micrograph (FE-SEM) of fractured surfaces of the sintered samples confirmed spherical shape of the grains. The average grain size

lies between (144-724) nm, smallest for La-doped sample and largest for Eu-doped sample.

7. X-ray photoelectron spectroscopy (XPS) studies of few representative samples indicated that in these samples Sr exists in Sr^{2+} whereas, Sn in both Sn^{2+} and Sn^{4+} states. Further, XPS confirmed presence of oxygen vacancies ($V_{\ddot{O}}$) and interstitial oxygen (O_i) as defects in the samples.
8. The value of dielectric constant and dissipation factor of undoped Sr_2SnO_4 is found to be 270 and 0.60. In improvement in the dielectric properties of Sr_2SnO_4 has been found on substitution of Ba^{2+} at Sr^{2+}. This result indicated that Ba doped samples can be suitable candidates for thermally stable capacitor applications.
9. On incorporation of La at Sr site, an enhancement of one order of magnitude in the value of dc conductivity has observed for the sample $Sr_{1.96}La_{0.04}SnO_4$ (7.28 x 10^{-5} S-cm^{-1}).
10. The Photoluminescence spectrum of Nd-doped samples exhibited most intense transition at 1064 nm (for sample $Sr_{1.94}Nd_{0.06}SnO_4$) which falls in IR region and hence possibility use of Nd doped samples for IR detector applications. Further, a clear ferromagnetic nature (M_s = 0.026 emu/gm and H_c = 20 Oe) observed for sample $Sr_{1.98}Nd_{0.02}SnO_4$ has indicated use of this material for spintronics applications.
11. The photoluminescence properties of Eu-doped samples exhibited two most intense transitions at 574 nm and 614 nm of Eu^{3+} for the sample $Sr_2Sn_{0.94}Eu_{0.06}O_4$ indicating application of this sample for optical imaging and optical device applications.

8.2 Future Scope

The experimental results reported in this thesis are preliminary results. There are no reports available in the literature on these samples for the comparison therefore, further systematic and more detail studies are required. Due to time bounded in Ph.D. program, these studies which could not be possible but require to support above mentioned results and conclusions are listed;

1. More detail exercise on the optimization of processing parameters is required to get best results of the samples.
2. Measurement of Seebeck and Hall coefficients of the samples to understand electrical properties of the samples in depth.
3. Study of electrical properties of synthesized samples with respect to partial pressure of oxygen to reveal nature of conducting species (electronic or ionic).
4. Measurement of transfer number to separate out contribution of electronic and ionic conductivity.
5. Measurement of AC magnetic susceptibility to understand magnetic properties in more detail.
6. Application oriented measurements to explore possibility of use of these materials in device fabrication.
7. The theoretical modelling of structure and properties of these materials are also required for better understanding of conduction mechanism.