# CHAPTER V

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## SUMMARY AND CONCLUSIONS

Despite a lot of published work ; the pyrochlore with chemical formula $A_2B_2O_7$ continuous to be an interesting material because, it has potential electronic and nuclear applications (1). The electrical properties of pyrochlores have been studied by many workers (2-7). Its electrical properties can be modified such as insulating to semiconductor or insulating to metal transition by substituting A and B elements, also these can be modified with oxygen content and its distribution. The present work deals with the electrical properties of pyrochlores with chemical formula $A_2B_2O_7$, where, A = Y. Ce and Sm and B = Ti and Sn.

The work presented in this dissertation is distributed into five chapters Chapter One presents an introductory review of the oxide pyrochlores and their applications (8). In the Chapter Two, the ceramic method is discussed briefly. The actual preparation of samples is also given. In the same chapter the X-ray diffraction patterns reveal single phase pyrochlore structure. The lattice constants and bond lengths are calculated.

The increase in lattice constant is related to the larger ionic radii of substituting atom. The porosity of these samples is $\leq 17\%$. The particle size is determined with the help of X-ray diffraction peaks.

Chapter Three deals with Electrical resistivity and Thermo emf study. The basic electrical properties are briefly reviewed. Experimental details with necessary formulae are given. The electrical resistivity Vs temperature plots show anomalous behavior upto 400°K and follows a semiconductor behavior above that temperature. The present results indicates that the conduction from ionic drift current is predominant in this anomalous region. From thermo emf data it is observed that all the samples shows n-type semiconductor behavior and n-to-p transition occurs around 450 to 550°K. Above this temperature they exhibit, p-type semiconductor behavior.

The conduction phenomena is determined by the effect of concentration and mobility of charge carriers. In pyrochlore depending on A and B elements as well as temperature and oxygen pressure interaction with atmosphere can take place the following reactions (2).

$$V''_o + 1/2\ O_2 \rightleftharpoons O_o + 2h^{\cdot}$$

$$O_o \rightleftharpoons 1/2\ O_2 + V''_o + 2e^{\cdot}$$

and hence under certain condition p or n-type defect exists, hence the observed variations for the present systems may be due to oxygen concentration.

The chapter four presents the dielectric properties. The basic theory of polarization and dielectric constant is discussed briefly. The dielectric measurements are carried out in the frequency range 20 Hz to 1MHz with the help of Hewlett Pacard precision LCR meter.

All the samples reveal the dielectric dispersion. The dielectric constant decreases rapidly with increase in frequency and reaches a constant value. The intrinsic dielectric constant values are found to be 10 to 20. The overall dielectric behavior of these materials has been proposed to have contributions from grains, grainboundaries and solid electrode interfaces. These formation of barrier layers is confirmed by plotting Cole-

Cole plots. From these plots it is observed that samples $Y_2Ti_2O_7$, $Sm_2Ti_2O_7$, $Ce_2Ti_2O_7$ and $Ce_2Sn_2O_7$ shows a single semicircle with a center on $\varepsilon'$ axis, which suggests that there is single value of relaxation time. The semicircles with a center below $\varepsilon'$ axis. It suggests that the distribution of relaxation time.

From the plots of dielectric constant Vs temperature at fixed frequency 1 KHz, it is observed that dielectric constant slowly decreases and becomes steady at a particular temperature range and again it increases with increase of temperature. The temperatures of minima in dielectric constant n-to-p transition and maxima in resistivity are nearly same. At higher temperatures the increase in dielectric constant is due to exponential decrease of electrical resistivity.

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