PREFACE

The preparation of oxide glasses by sol-gel method and the study of their electrical and luminescent properties form the subject of this thesis The thesis is divided into 4 chapters The references related to each chapter are given after Chapter - IV

The first chapter is an introductory chapter It presents, in brief, the different methods of glass preparation - melt quenching method, sol-gel method, thermal evaporation, sputtering, glow discharge decomposition and chemical vapour deposition methods The terms 'glass former', 'glass modifier' and 'glass transition' are discussed The chapter also contains a brief description of the methods used to study the structure of solids The methods include X-ray diffraction, NMR, Raman spectroscopy and neutron diffraction Glasses being disordered solids, various structural models of glass are given by earlier workers The continuous random network theory, random packing model, random coil model, Monte Carlo simulation and dynamical simulation are summarised

A brief note on the electrical conductivity which has two components -electronic and ionic, is given in the chapter The phenomenon of luminescence in solids is presented at the end of the chapter Different mechanisms of luminescence are discussed in brief, with particular reference to thermoluminescence

The second chapter presents the details of sol-gel method of glass preparation The chapter begins with the details of two methods of gel preparation namely, the hydrolysis and polycondensation method and the colloidal method The process of drying the gel and the conversion of gel into glass are also discussed

The experimental details of sample preparation by the present worker is given in this chapter In the present study, sodium metasilicate was used as the starting material The samples obtained were binary glass Na_2O-SiO_2 and ternary glasses Na_2O-SiO_2-ZnO, Na_2O-SiO_2-P_2O_5, Na_2O-SiO_2-Li_2O and Na_2O- SiO_2-Mn_3O_4 The chemical reactions during gel formation and also those during the gel to glass conversion are also discussed Finally, the methods to confirm the gel to glass trasition and its amorphous nature are described The DTA plot of gel-glass transition, X-ray diffractogram to confirm the amorphous nature of the sample and the IR transmission spectra are presented The limitations of the sol-gel method with regard to variations in the compositions are pointed out

Chapter - III deals with the study of d c conductivity of silicate glasses prepared by the present worker The chapter begins with discussion of Arrhenius equation followed by an account of the transport mechanism in glasses The models like Anderson-Stuart approach, the weak electrolyte theory, defect models, small polaron model, variable hopping model and percolation models are discussed briefly The d c conductivity studies by earlier workers are summarised

The experimental details of the d c conductivity measurements undertaken in the present work are presented in detail The set up developed for the purpose is described The conductivity was measured using two probe method for all glass samples as a function of temperature Conductivity and activation energy values are compared with those obtained by earlier workers for different oxide glasses The results indicate that the conductivity in the present samples are due to ionic motion

The study of thermoluminescence in glass systems is the subject of Chapter IV The chapter begins with a summary of the earlier work on thermoluminescence (TL) in glasses This is followed by a brief discussion of the different methods used for the evaluation of kinetic parameters like activation energy, the kinetic order and the pre-exponential factor The method based on the area under the glow curve was found to be reliable because it does not need any assumption of the kinetic order

The experimental set up is described in detail In all cases, the glow curve was found to be slightly asymmetric with the higher temperature part of the curve being more steep The TL studies are also presented after allowing idle time between X-irradiation and sample heating

In conclusion, the present worker has successfully prepared silicate glasses by sol-gel method using sodium metasilicate as the starting material The results of d c conductivity measurements agree reasonably well with those reported by earlier workers on similar glass systems All samples were found to exhibit weak thermoluminescence The results are analysed using different methods