## Abstract

### Chapter I Introduction

1.1 Introduction
- Definition of a glass

1.2 Features of glass
- 1.2.1 Atomic arrangement
- 1.2.2 Chemical composition
- 1.2.3 Thermodynamic Features
- 1.2.3 Optical Features

1.3 Important systems of glass.
- 1.3.1 Oxide glasses
- 1.3.2 Non-silicate glass
- 1.3.3 Halide glasses
- 1.3.4 Chalcogenide glasses

1.4 Glass nanocomposite.
- 1.4.1 Semiconductor quantum dots in glass matrix.
- 1.4.2 Dilute magnetic Semiconductor quantum dots in glass matrix

1.5 Brief survey of the Magneto-Optical and Nonlinear Optical materials.
- 1.5.1 Magneto-Optical materials.
- 1.5.2 Non linear optical (NLO) materials.

1.6 Bismuth chalcogenide in glass matrices.
- 1.6.1 Crystal structure of Bi$_2$S$_3$
- 1.6.2 Crystal structure of Bi$_2$Te$_3$

1.7 Motivation of the work

References
Chapter 2 Fundamental and Experimentation

2.1 Introduction

2.2 Semiconductor quantum dots in a glass matrix. (Like Bi₂S₃ and Bi₂Te₃):
   Synthesis methods
   2.2.1 Chemical Vapor deposition methods:
   2.2.2 Sol-gel methods:
   2.2.3 Glass by melt-quenching technique

2.3 Magneto-optical Faraday rotation:
   2.3.1 Introduction:
   2.3.2 Magneto-optical Faraday rotation theory:

2.4 Nonlinear optics
   2.4.1 Introduction
   2.4.2 Nonlinear absorption and refractive index
   2.4.3 Nonlinear absorption and refractive index: Theory

2.5 Experimentation:
   2.5.1 Melt and quench method

2.6 Characterization techniques:
   2.6.1 X-ray diffraction (XRD):
   2.6.2 Transmission Electron Microscope (TEM):
      2.6.2.1 Bright field imaging:
      2.6.2.2 Dark field imaging:
   2.6.3 Ultra Violet Visible Spectroscopy (UV-Vis):
   2.6.4 Photoluminescence (PL):
   2.6.5 Ellipsometry
      2.6.5.1 Experimental setup
      2.6.5.2 Data acquisition
      2.6.5.3 Data analysis
   2.6.6 Thermogravimetric analysis
   2.6.7 Thermo-Mechanical Analysis (TMA)
2.7 Magneto-optical Faraday rotation measurement setup 62
   2.7.1 Faraday rotation measurement setup 62
   2.7.2 Calculation of Faraday angle and Verdet constant 65
2.8 Nonlinear absorption studies using the standard Z-scan technique 67
References 69

Chapter 3 Synthesis of Bismuth Sulfide quantum dots / wires-glass nanocomposite and its Magneto optical Faraday rotation.

3.1 Introduction 72
3.2 Experimental 73
   Optimization for controlled synthesis of Glass nanocomposite 73
3.3 Results and Discussion 77
   3.3.1 TEM Analysis: 78
   3.3.2 XRD studies: 81
   3.3.3 Optical studies: 83
   3.3.4 Photoluminescence Studies 87
   3.3.5 Faraday Rotation measurement: 88
3.4 Conclusion 91
References 93

Chapter 4 Synthesis of Bismuth Sulfide quantum dots / wires-glass nanocomposite and its Magneto optical Faraday rotation.

4.1 Introduction 94
4.2 Experimental Details 96
4.3 Result and Discussions 98
   4.3.1 Thermal analysis 98
   4.3.2 XRD studies 99
   4.3.3 HRTEM studies 100
Chapter 5 Growth of Bi$_2$Te$_3$ quantum dots/rods in glass and its Magneto-optical Faraday rotation measurements

5.1 Introduction
5.2 Experimental Section
5.3 Result and Discussions
  5.3.1 XRD studies
  5.3.2 TEM analysis
  5.3.3 Growth mechanism
  5.3.4 Optical studies
  5.3.5 Photoluminescence studies
  5.3.6 Magneto-Optical Studies
5.4 Conclusions
References

Chapter 6 Nonlinear absorption, scattering and optical limiting studies of Bi$_2$S$_3$ and Bi$_2$Te$_3$ nanoparticles in glass matrix

5.1 Introduction
5.2 Experimental Section
  6.2.1 Sample Preparations
  6.2.3 Nonlinear absorption studies using the standard Z-scan technique
5.3 Result and Discussions
  6.3.1 Optical studies
  6.3.2 TEM analysis
References
6.3.3 Nonlinear Optical Properties with nanosecond laser
   6.3.3.1 Nonlinear Optical Properties Bi₂S₃ 154
   6.3.3.2 Nonlinear Optical Properties of Bi₂Te₃ 155
6.4 Conclusion 157
References 158

**Chapter 7 Summary and Conclusions**

7.1 Conclusions 161
7.2 Future scope 166

**List of Publications** 167
**Patents** 169
**National/International Conferences attended** 169