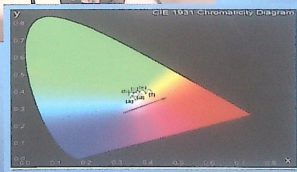


*CALORIMETRIC INVESTIGATION AND*  
**ELECTRICAL PROPERTIES OF**  
SILVER ION DOPED  
**LEAD BORATE GLASSES**



Dr. Giri Madan Anantgir



## CALORIMETRIC INVESTIGATION AND ELECTRICAL PROPERTIES OF SILVER ION DOPED LEAD BORATE GLASSES

© DR. MADAN A. GIRI

❖ Publisher :

Harshwardhan Publication Pvt.Ltd.  
Limbaganesh, Dist. Beed (Maharashtra)  
Pin-431126, vidyawarta@gmail.com

❖ Printed by :

Harshwardhan Publication Pvt.Ltd.  
Limbaganesh, Dist. Beed, Pin-431126  
www.vidyawarta.com

❖ Page design & Cover :

H.P. Office (Source by Google)

❖ Edition: Nov. 2021

ISBN 978-93-92584-02-2



❖ Price : 200/-

All Rights Reserved, No part of this publication may be reproduced, or transmitted, in any form or by any means, electronic mechanical, recording, scanning or otherwise, without the prior written permission of the copyright owner. Responsibility for the facts stated, opinions expressed. Conclusions reached and plagiarism, if any, in this volume is entirely that of the Author. The Publisher bears no responsibility for them. What so ever Disputes, if any shall be decided by the court at Beed (Maharashtra, India)

# CONTENTS

| CHAPTER | TITLE                                                | PAGE NO.  |
|---------|------------------------------------------------------|-----------|
| I       | INTRODUCTION                                         | ... 11-41 |
|         | 1.1 Introduction                                     |           |
|         | 1.2 Definition of Glass                              |           |
|         | 1.2.1 Crystal                                        |           |
|         | 1.2.2 Amorphous materials                            |           |
|         | 1.2.3 Polycrystalline solid                          |           |
|         | 1.3 Classification of Glasses                        |           |
|         | 1.4 Classification of Amorphous Materials            |           |
|         | 1.5 Review of Oxide Glasses                          |           |
|         | 1.6 Application of Glasses                           |           |
|         | 1.7 Need of Investigation                            |           |
|         | 1.8 Aim of the Present Work and Selection of Glasses |           |
|         | ◇ References                                         |           |
| II      | STRUCTURE OF GLASSES                                 | ... 42-62 |
|         | 2.1 Introduction                                     |           |
|         | 2.2 Structure of Oxide Glasses                       |           |
|         | 2.2.1 Borate glasses                                 |           |
|         | 2.2.2 Phosphate glasses                              |           |
|         | 2.2.3 Silicate glasses                               |           |
|         | 2.2.4 Germanate glasses                              |           |
|         | 2.3 Models of Glass Structure                        |           |
|         | 2.3.1 Density and molar volume                       |           |
|         | 2.3.2 Crystalline model                              |           |
|         | 2.3.3 Random network model                           |           |
|         | 2.3.4 Simulations                                    |           |
|         | 2.3.4.1 Monte Carlo simulations                      |           |
|         | 2.3.4.2 Molecular dynamical simulation               |           |

| CHAPTER | TITLE                                                            | PAGE NO.  |
|---------|------------------------------------------------------------------|-----------|
|         |                                                                  |           |
|         | 2.4 Various Factors Affecting the Glass Structure                |           |
|         | 2.5 Methods of Investigation of Glass Structure                  |           |
|         | 2.5.1 IR spectroscopy                                            |           |
|         | 2.5.2 X-Ray spectroscopy                                         |           |
|         | 2.5.3 Scanning electron microscope                               |           |
|         | 2.5.4 Density and molar volume                                   |           |
|         | 2.6 Role of Glass Former and Modifiers in the Structure of Glass |           |
|         | ❖ References                                                     |           |
|         |                                                                  |           |
| II      | THEORETICAL CONCEPT                                              | ... 63-83 |
|         | 3.1 Introduction                                                 |           |
|         | 3.2 Structural Characterization                                  |           |
|         | 3.2.1 Fourier transform infrared spectroscopy (FTIR)             |           |
|         | 3.2.2 Differential scanning calorimetry (DSC)                    |           |
|         | 3.3 Transference Number                                          |           |
|         | 3.4 Theory of Ionic Conductivity                                 |           |
|         | 3.5 Ionic Polaron Theory                                         |           |
|         | 3.6 Dynamics of Ion Transport                                    |           |
|         | 3.6.1 Free-ion model                                             |           |
|         | 3.7 Impedance Measurements                                       |           |
|         | 3.8 Dielectric Constant                                          |           |
|         | ❖ References                                                     |           |
|         |                                                                  |           |
| IV      | EXPERIMENTAL                                                     | ... 84-95 |
|         | 4.1 Introduction                                                 |           |

|         |       |                                           |             |
|---------|-------|-------------------------------------------|-------------|
|         | 4.2   | Various Methods of Glass Fabrication      |             |
|         | 4.3   | Glass Preparation                         |             |
| CHAPTER |       | TITLE                                     | PAGE NO.    |
|         |       |                                           |             |
|         | 4.4   | Structural Characterization               |             |
|         | 4.4.1 | X-ray diffraction (XRD)                   |             |
|         | 4.4.2 | Fourier transform infrared spectra (FTIR) |             |
|         | 4.4.3 | Differential scanning calorimetry (DSC)   |             |
|         | 4.4.4 | Thermogravimetry (TG/DTG)                 |             |
|         | 4.5   | Measurement                               |             |
|         | 4.5.1 | Density and molar volume                  |             |
|         | 4.5.2 | DC Electrical conductivity                |             |
|         | 4.5.3 | Impedance and dielectric constant         |             |
|         | 4.5.4 | Transference number                       |             |
|         | ❖     | References                                |             |
| V       |       | RESULTS AND DISCUSSION                    | ... 96-204  |
|         | 5.1   | Structure                                 |             |
|         | 5.1.1 | X-ray diffraction (XRD)                   |             |
|         | 5.1.2 | Fourier transform infrared spectra (FTIR) |             |
|         | 5.1.3 | Differential scanning calorimetry (DSC)   |             |
|         | 5.1.4 | Thermogravimetry (TG/DTG)                 |             |
|         | 5.2   | Density and Molar Volume                  |             |
|         | 5.3   | Transference Number                       |             |
|         | 5.4   | DC Conductivity                           |             |
|         | 5.5   | Impedance Measurements                    |             |
|         | ❖     | References                                |             |
| VI      |       | CONCLUSIONS                               | ... 208-209 |
| VII     |       | RESUME                                    | ... 210-213 |
|         |       | References                                |             |
|         |       | APPENDIX                                  |             |



Dr.Giri Madan Anantgir teacher physics at Gramin (Arts, Science and commerce) Mahavidyalaya Vasantnagar, Mukhed Dist Nanded. He obtained his M.Phil at Sant Gadge Maharaj University Amravati and Ph.D. on Swami Ramanand Teerth Marathwada University Nanded. He worked one minor research project under the financial assistance of University Grants Commission. He is recognized Research guide. He has presented Papers in national and international conferances and published in journals.



Harshwardhan Publication Pvt.Ltd.  
At Post.Limbaganesh, Tq.Dist Beed  
Pin-431 126 (Maharashtra)  
Mob 09850203295



ISBN :978-93-92584-02-2