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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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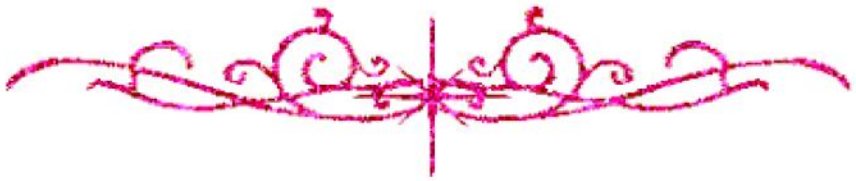

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بالرسالة صفحات

لم ترد بالأصل

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STRUCTURAL INVESTIGATIONS OF FLUORIDE GLASSES

A THESIS

Submitted for the Degree of Doctor of Philosophy in Solid State Physics to Physics Department, Faculty of Science, Menoufia University, Egypt

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To

MY Dear Parent,

My Love Wife Hala

and

My Daughters, Hadil and Iman

CONTENTS

ABSTRACT

ABSTRACT

New fluoride glasses have been synthesized in ternary and quaternary systems based on NbO_2F-BaF_2-RF where RF are the alkali fluoride, LiF, NaF, KF and mixed fluoride NaF-LiF. These glasses were prepared by the usual melt-quench technique.
The effect of RF instead of NbO_2F on the glass forming range, physical properties and structure investigations of the produced fluoride glasses have been studied.

Glass densities were determined by the use of Archmedes' method and so the corresponding molar volume were calculated.

The physical properties of these glasses such as thermal properties have been carried out by applying the DSC technique. This has been done in order to find endothermic peak due to the glass transition temperature T_g, exothermic peak due to the glass crystallization T_c and endothermic peak due to the melting temperature T_m. From these results the glass stability factor S and the activation energy of crystallization E_a have been calculated. Also, thermal expansion coefficient **a** and specific heat C_p were determined.

The optical properties of the present new glasses such as the refractive index n_D has been measured and so the molar refractivity R_m has been calculated. From the dielectric theory, the relationship between the refractive index and number of ions /unit volume (N/V) with polarizability α' has been discussed. UV-spectra have been measured in order to calculate the optical energy

gap E_{opt} and the width of the tails of the localized states in the band gap E_{tail} of the present glasses.

The structural investigations of the present glasses have been implemented by using IR spectrophotometer in the range 400-1200 cm^{-1} of wavenumber and Raman scattering in the range of 200-1150 cm^{-1} of wavenumber. The observed absorption bands were assigned to their vibrational modes.

Finally the Brillouin scattering was used in order to determine the longitudinal wave velocity and elastic modulus for the tested glasses.

All the thermal, optical and mechanical properties of these fluoride glasses have been found to be very sensitive to the composition, i.e. depend on the presence of alkali fluoride, LiF, NaF and mixed NaF-LiF.

CHAPTER 1

INTRODUCTION

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1_1 *The Glass Formation Behaviour of Halides*

An increasing interest is devoted in general, to halide glasses because of their potential use for making infrared optical components and ultra-low-loss optical fibres for laser applications and specific properties such as ionic conductivity.

The history and actual situation of glass chemistry are largely dominated by oxide systems. The glass-forming ability which requires the creation of a strong tridimentional 3D covalent bond is characteristic of small highly charged cations as found in oxides such as B_2O_3, SiO_2, P_2O_5..... The lowering of energy due to the intrinsic disorder arising from the periodicity of the glass lattice is balanced by the very strong metal-oxygen bond originating from the overlapping of the atomic orbitals of M and O in the 3D directions.

The situation is different with halides X = F, Cl, Br and I, especially with fluorine which is the most electronegative elements. When associated with a metal, they generally have a great tendency to monopolize the bonding electrons and to give a pure ionic bond, which consequently enhances the crystalline state whose stability is governed by Coulombic forces. The difficulty in stabilizing halide glasses is demonstrated by their recent discovery and their absence as a natural materials.