Effect of iron and sodium inclusion on some properties of silicate glass

Cite as: AIP Conference Proceedings **2115**, 030224 (2019); https://doi.org/10.1063/1.5113063
Published Online: 12 July 2019

Manjunath T. Nayak, J. A. Erwin Desa, and P. D. Babu

RESEARCH ARTICLE | JULY 11 2019

Effect of iron and sodium inclusion on some properties of silicate glass

Manjunath T. Nayak ; J. A. Erwin Desa; P. D. Babu

— Author & Article Information

Manjunath T. Nayak [1,a)], **J. A. Erwin Desa** [1], **P. D. Babu** [2]

[1] Department of Physics, Goa University, Taleigao Plateau-403206, India

[2] UGC DAE CSR, Mumbai Center R-5 Shed, BARC, Trombay, Mumbai-400085, India

[a)]Corresponding author: manjunathscifi@gmail.com

AIP Conf. Proc. 2115, 030224 (2019)

https://doi.org/10.1063/1.5113063

glass transition temperatures T_g in this series can be correlated to the relative fractions of Fe^{2+} and Fe^{3+} as well as Na^{+} ions present in these glasses. UV-Visible spectra showed a trend of optical band gap with Na concentration which is related to the fraction of non-bridging oxygen atoms present in each glass. Magnetization studies showed these glasses to be purely paramagnetic at room temperature but at a temperature of 5K, to have some

CONTRIBUTED PAPERS

Light up-conversion and structural properties of Sn and Er^{3+} doped $Ba_{.995}Er_{.005}(Sn_{.06}Ti_{.94})O_3$ ceramics

Mohd. Azaj Ansari; K. Sreenivas

AIP Conf. Proc. 2115, 030001 (2019) https://doi.org/10.1063/1.5112840

Abstract View article PDF

Influence of thermal annealing on phase transformation in $Bi_{10}As_{40}Se_{50}$ thin films

Mukta Behera; N. C. Mishra; R. Naik

AIP Conf. Proc. 2115, 030002 (2019) https://doi.org/10.1063/1.5112841

Abstract View article PDF

Pressure induced re-entrant order-disorder like structural phase transition in spinel ferrite nanoparticles

Inaugural x-ray magnetic circular dichroism spectra on epitaxial Fe_3O_4 thin films using Indus-2 synchrotron bending magnet source

D. M. Phase; R. J. Choudhary; Gyanendra Panchal; A. D. Wadikar; Rakesh Sah.

AIP Conf. Proc. 2115, 030223 (2019) https://doi.org/10.1063/1.5113062

Abstract | View article | PDF

Effect of iron and sodium inclusion on some properties of silicate glass

Manjunath T. Nayak; J. A. Erwin Desa; P. D. Babu

AIP Conf. Proc. 2115, 030224 (2019) https://doi.org/10.1063/1.5113063

Abstract | View article | PDF

Optical properties of zirconium doped sodium-boro-zinc fluoride glasses

Roopa; B. Eraiah

AIP Conf. Proc. 2115, 030225 (2019) https://doi.org/10.1063/1.5113064

Abstract | View article | PDF

Copper-induced majority charge carrier reversal in bismuth telluride-based nanothermoelectrics

Niraj Kumar Singh; Ganpati Ramanath; Ajay Soni

AIP Conf. Proc. 2115, 030625 (2019) https://doi.org/10.1063/1.5113464

Abstract | View article | PDF

Growth of silver nanoparticles on titanium dioxides layer for plasmonic-based solid-state solar cells

Sanjay K. Sardana; Piyush K. Parashar; P. S. Chandrashekar; Sanjay K. Srivastava; Vamsi K. Komarala

AIP Conf. Proc. 2115, 030626 (2019) https://doi.org/10.1063/1.5113465

Abstract | View article | PDF

Online ISSN 1551-7616 Print ISSN 0094-243X

Effect of Iron and Sodium Inclusion on Some Properties of Silicate Glass

Manjunath T. Nayak[1a)], J. A. Erwin Desa[1] and P. D Babu[2]

[1]*Department of Physics, Goa University, Taleigao Plateau-403206, India*
[2] *UGC DAE CSR, Mumbai Center R- 5 Shed, BARC, Trombay, Mumbai-400085, India*

[a)]*Corresponding author: manjunathscifi@gmail.com*

Abstract: Sodium silicate glasses with a fixed molar percentage of iron and varying percentages of sodium alkali have been synthesized by the method of melt quenching in air. The variation of glass transition temperatures T_g in this series can be correlated to the relative fractions of Fe^{2+} and Fe^{3+} as well as Na^+ ions present in these glasses. UV-Visible spectra showed a trend of optical band gap with Na concentration which is related to the fraction of non-bridging oxygen atoms present in each glass. Magnetization studies showed these glasses to be purely paramagnetic at room temperature but at a temperature of 5K, to have some ferromagnetic character with a ten-fold enhanced magnetization.

INTRODUCTION

Iron is one of the most abundant naturally occurring elements and finds itself as a component in silicate glasses found in nature. The role of iron in the structures of silicate glasses has been the subject of much scientific study. Iron when introduced in a glass possesses dual redox states irrespective of its initial oxidation state. Iron in the trivalent state, Fe^{3+}, is reported to be a network former while Fe^{2+} has a network modifying role [1].

Weigel et al. (2008) and A.C. Wright et al. (2014) have examined soda lime silicate glasses containing iron. The detailed study on these samples show that the property of such glasses are highly dependent on the ratio of Fe^{2+} to Fe^{3+}. The final average of these redox states would have a major effect on the mechanical, structural and spectroscopic properties of these glasses [4-6].

The majority of studies have been made on silicates with variable concentrations of iron in the glass. Few if any authors have examined the properties of these glasses when the iron has been kept constant with variable concentrations of silicate and an alkali ion such as sodium. Presented here are thermal, spectroscopic and magnetic properties of sodium silicate glass with iron kept at a fixed level.

EXPERIMENTAL

Compositions and Preparation

The constituent oxide powders used for the preparation of each glass sample were mixed together in the required relative amounts to yield the desired composition. These initial molar percentages are listed in Table 1. Sodium oxide was derived from sodium carbonate - being a stable salt of sodium - which releases carbon dioxide during the heating process. The samples are coded as Na1, Na2, Na3 and Na4, where Na1 is the glass without iron.

All the samples were synthesized by the melt quench method using a platinum crucibles in batches of 15 g in a 1600 C Carbolite furnace. The mixtures were initially heated to 900 C and held at this temperature for 1 hour for the decomposition of sodium carbonate to sodium oxide. The crucible were held at 1400 C for 15 minutes before removal to an ambient air temperature and cooling within the crucible. The samples were then transferred to a pre-heated (350 C) muffle furnace and cooled overnight to room temperature.

DAE Solid State Physics Symposium 2018
AIP Conf. Proc. 2115, 030224-1–030224-4; https://doi.org/10.1063/1.5113063
Published by AIP Publishing. 978-0-7354-1851-6/$30.00