زانکۆی سەلاحەدین - هەولێر
Salahaddin University-Erbil

Effect of Annealing Temperature on Physical and Optical Properties of Soda–Lime Glass

A Research Project

Submitted to the department of Physics in partial fulfillment of the requirements for the degree of BSc. in Physics

BY:

Gawhar Saadi Ali

Supervised by:

Assist. Prof. Dr. Saman Q. Mawlud

April– 2024

Effect of Annealing Temperature on Physical and Optical Properties of Soda–Lime Glass

Approved by:

Assist. Prof. Dr. Saman Q. Mawlud

Dr.

Dr.

Date Approved: April 1, 2020

DEDICATION

Special dedicated:

- To my dear parents, whose love, kindness patience and prayer have brought me this far
- To all my very diligent teachers, for their endless help and effective teachings

Thank you very much!

ACKNOWLEDGEMENTS

Firstly, and the most importantly, I would like to thank Allah the ultimate until the end day comes who have wonderful plans for me and have guided me to here at this moment. He has kept me strong and focused so that I would not go wrong, higher council and presidency of the Salahaddin university would like to express my deepest thanks and gratitude to my supervisor Assist. Prof. Dr. Saman Qadir Maulud, for his keen supervision initiating and planning this study, great help, and scientific guidance I am grateful for his patient and valuable comments sincere thanks and appreciation to all my friends in the physics department who supported me during my study last but not least would like to express my appreciation and gratitude to my parents, sister and brothers, for all the supports, patience and encouragement they provide during my studies.

SUMMARY

Soda-lime glass, commonly known as “float glass” is used in everyday products and devices such as solar cells, household mirrors, automobile glass, architectural building windows, etc. Understanding the bulk optical properties of soda-lime float glass and the surface layers which form on the air and tin sides is important for subsequent characterization of deposited coatings on soda-lime glass. Float glass typically has a characteristic green tint, resulting in absorption over a broad spectral range from visible to infrared wavelengths. This bulk absorption and green tint are generally attributed to addition of iron oxide into the glass; other additives can also be used to produce different colors of soda-lime glass. In this project, we used UV-Vis-NIR spectroscopy for characterizing the absorption properties of annealed soda-lime float glass at different annealing temperatures. In summary, while there may be some indirect correlations between density and absorption in glass, the relationship is complex and depends on various factors such as atomic packing density, impurity content, crystallinity, and structural arrangement. Therefore, it is essential to consider multiple factors when studying the absorption properties of glass, rather than relying solely on density as a predictor of absorption. Generally, a higher density implies a more tightly packed structure with fewer void spaces between atoms. In such cases, there may be fewer opportunities for light to penetrate the material, leading to lower absorption. In summary, the effect of annealing temperature on absorption in glass is complex and depends on various factors including structural changes, crystallization, defects and impurities, annealing stress, and chemical composition. Experimentation and analysis are often required to understand how annealing temperature specifically influences the absorption properties of a particular type of glass.

LIST OF CONTENTS

References

Agrawal, D.C., (2013). Introduction to nanoscience and nanomaterials. World Scientific.

Atkins, P., (2010). Shriver and Atkins' inorganic chemistry. Oxford University Press, USA.

Cao, G. and Wang, Y., (2011). Nanostructures and Nanomaterials: synthesis, Properties and Applications. 2nd edition, World Scientific Publishing Co Pte Ltd.

El-Mallawany, R., (2002). Handbook of tellurite glasses, physical properties & data.

El-Mallawany, R., (2011). Tellurite glasses handbook: physical properties and data. CRC press.

Funabiki, F., Kamiya, T. and Hosono, H., (2012). Doping effects in amorphous oxides. Journal of the Ceramic Society of Japan, 120(1407), pp.447-457.

Greenwood, N. N., Earnshaw, A., (1984). Chemistry of the elements. Pergamon press oxford.

Holand, W. and Beall, G.H., (2012). Glass ceramic technology. John Wiley & Sons.

Hruby, A. Evaluation of glass-forming tendency by means of DTA. Czech. J. Phys., (1972), 22:1187-1193.

Huang, C.H., (2011). Rare earth coordination chemistry: fundamentals and applications. John Wiley & Sons.

Jacob, R.R. and Weber, M.J., (1976). IEEE J. of Quantum Electron. QE-12, 102(1), p.976.

Kittle, C. (1971). Introduction to Solid State Physics. New York: Wiley.

Kuzmany, H., (2009). Solid-state spectroscopy: an introduction. Springer Science & Business Media.

Mott, N.F. and Davis, E.A., (2012). Electronic processes in non-crystalline materials. OUP Oxford.

Rasmussen, S.C., (2012). How Glass Changed the World: The History and Chemistry of Glass from Antiquity to the 13th Century, Vol. 3. Springer Science & Business Media.

Shelby, J.E., (2005). Introduction to glass science and technology. Royal Society of Chemistry.

Ter-Mikirtychev, V., (2013). Fundamentals of fiber lasers and fiber amplifiers (Vol. 181). Springer.

Xie, R.J., Li, Y.Q., Hirosaki, N. and Yamamoto, H., (2016). Nitride phosphors and solid-state lighting. CRC Press.

Zachariasen W. H., (1932). THE ATOMIC ARRANGEMENT IN GLASS, J. Am. Chem. Soc., 54 (10), pp 3841–3851.

Zhang, J.Z., (2009). Optical properties and spectroscopy of nanomaterials. Singapore: World Scientific.