

UNIVERSITI TEKNOLOGI MARA

**EFFECT OF Nd_2O_3 / Y_2O_3 DOPING
ON THE PHYSICAL, ELASTIC,
STRUCTURAL AND OPTICAL
PROPERTIES OF LEAD
BOROTELLURITE GLASS SYSTEM**

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Science)

Faculty of Applied Sciences

December 2021

ABSTRACT

Two series of lead borotellurite glasses doped with neodymium and yttrium oxide with the composition of $(49-x)\text{H}_3\text{BO}_3-35\text{TeO}_2-15\text{PbO}-1.0\text{Y}_2\text{O}_3-x\text{Nd}_2\text{O}_3$ (Nd-series glass) and $(49-x)\text{H}_3\text{BO}_3-35\text{TeO}_2-15\text{PbO}-1.0\text{Nd}_2\text{O}_3-x\text{Y}_2\text{O}_3$ (Y-series glass) where $0.0 \leq x \leq 2.5$ mol% were prepared using melt-quenched method. The physical properties of all glass such as density, molar volume, oxygen packing density as well as elastic properties were measured. The structural properties of the glasses were studied using X-ray diffraction (XRD) analysis, Fourier Transform Infrared Spectroscopy (FTIR), Raman spectroscopy and Energy Dispersive X-ray (EDX) spectroscopy analysis. The amorphous nature of the glass was investigated through XRD analysis, and all glass were confirmed to be amorphous in nature. FTIR and Raman analysis revealed the presence of Te-O bond in TeO_4 , TeO_3 and B-O bond in BO_4 and BO_3 in the prepared glasses. FTIR spectra analysis also indicated that the addition of Nd_2O_3 and Y_2O_3 content in the glass system tends to change the glass network due to the transformation of TeO_4 into TeO_3 and BO_4 into BO_3 and vice versa. Raman analysis showed there are some structural changes as dopant were added into the glass system where BOs and NBOs were created at the same time. The presence of all elements in the glass system were confirmed using EDX analysis. The optical properties of the glasses were tested using UV-Vis NIR and photoluminescence spectroscopy. The UV-Vis NIR results for both series glass shows eleven absorption peaks which are related to the main absorption spectra of Nd^{3+} ions. The absorption peaks that correspond to the transitions from the $^4\text{I}_{9/2}$ ground state to the $(^2\text{P}_{1/2} + ^2\text{D}_{5/2})$, $^2\text{D}_{3/2}$, $(^2\text{G}_{5/2}, ^2\text{K}_{15/2})$, $^4\text{G}_{9/2}$, $^4\text{G}_{7/2}$, $(^4\text{G}_{5/2}, ^2\text{G}_{7/2})$, $^2\text{H}_{11/2}$, $^4\text{F}_{9/2}$, $(^4\text{S}_{3/2}, ^4\text{F}_{7/2})$, $(^4\text{F}_{5/2}, ^2\text{H}_{9/2})$ and $^4\text{F}_{3/2}$ excited state. The optical band gap, E_{opt} shows that the E_{opt} for Nd-series glass increases and for Y-series glass initially decreased before slightly increasing with respect to the composition changes. The increase of E_{opt} in both series glass suggests the formation of BOs with respect to composition while the initial decrease of E_{opt} in Y-series glass was caused by weaker bond strength of yttrium oxide compared to other chemical oxide in the glass matrix. As the bond strength of Y-O bonds replace the other chemical bonds with larger bond strength, the average bond strength of the glass system will be decreased. As a result, the conduction band edge energy and the E_{opt} will reduce as well. The photoluminescence data reveal that for Nd_2O_3 concentration higher than 1.0 mol% and for Y_2O_3 concentration higher than 1.5 mol%, the photoluminescence peaks decreased in intensity. These concentrations represent the quenching concentration.

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and Most Merciful. Praise be upon Him for giving me the courage, strength, and patience to manage and complete this research project report entitled “Effect of $\text{Nd}_2\text{O}_3/\text{Y}_2\text{O}_3$ Doping on The Physical, Elastic, Structural and Optical Properties of Lead Borotellurite Glass System”.

First and foremost, I would like to express my gratitude to my supervisor Prof. Ts. Dr. Azhan Bin Hashim@Ismail, Dr. Wan Aizuddin Bin Wan Razali and Dr. Hasnimulyati Binti Laoding for their guidance, help, suggestions, and encouragement while I am doing this study. Unforgettable to my late supervisor Dr. Azman Bin Kasim, thanks for his guidance, help, moral support, and feedback throughout the duration of the preparation of this project and this thesis would have been impossible to accomplish without his support.

Special thanks are also dedicated to all my colleagues, Nurbaisyatul Ermiza Binti Suhaimi and Azliana Fitri Binti Halim for their wholehearted support especially for the significant information source and helpful discussions.

Also, a sincere appreciation to my beloved husband, Mohd Faidzal Bin Mohamed, to my sons, Muhammad Nazeem Fawwaz and Muhammad Nadheef Farhat, to my parents Hj. Mohd Rafien Bin Yajid and Hj. Safiah Binti Ismail, my parents in law, Hj. Nawi Bin Yussof and Hj. Naimah Binti Daud, to my family members for their endless continued love, prayer, understanding and inspiration towards me to help me achieve my final goal of obtaining a PhD.

Moreover, not to forget the Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM) Cawangan Pahang, Kampus Jengka for giving me the opportunity to conduct the project. Thank you to Science officers and lab assistants of the Faculty of Applied Sciences of UiTM Pahang for helping me in carrying out Electronic Densimeter and UV-Vis NIR Spectroscopy. Special thanks also to Science officers and lab assistants of the Faculty of Applied Science of UiTM Malaysia for helping me in carrying out Fourier Transform Infrared (FTIR) Spectroscopy. A lot of thanks also to the Science officers of the Faculty of Science Universiti Teknologi Malaysia for helping me in carrying out X-Ray Diffraction (XRD), Raman Spectroscopy and Photoluminescence Spectroscopy.

Last but not least, I would like to extend my heartfelt thanks to my friends and everyone those who have contributed directly or indirectly, that has helped me accomplish my goal. Thank you for the blessings and moral support that kept me in high spirits throughout my journey towards achieving this research work. I am also grateful to Universiti Teknologi MARA and Ministry of Higher Education for the financial support given for this research work.

Finally, I wish them every success in this world and hereafter under the guidance and in the path of ALLAH S.W.T.

Thank You.

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