CHAPTER 5 CONCLUSION

Virtually any materials can be formed as a glass under the proper experimental conditions. The property of glass depends on chemical compounds, elements or heat treatment. Glass affords considerable flexibility in size and shape, and can be doped or activated to excellent uniformity. The possibility to control physical and luminescence properties of glasses by a proper variation of glass composition suggests the feasibility of a chemical control of the materials according to the needs of respective applications. The objectives of this research were to investigate physical, optical properties, and luminescence properties of prepared bismuth borate glasses. These glasses were doped with the rare-earth (dysprosium, Dy).

5.1 General Characteristic of Glass Samples

This research, bismuth borate glass doped with dysprosium (Dy) in the form of chemical compound oxides (Dy_2O_3), prepared using the glass composition formula $30Bi_2O_3$: $(70\text{-}x)B_2O_3$: xDy_2O_3. Where x is 0.0, 0.5, 1.0, 1.5, 2.0, and 2.5 mol%. Bismuth borate glass samples were prepared by the use of the normal melt-quenching technique at the melting temperature of 1,100 ^{0}C at 3 hour time intervals. Glass samples were annealed at the temperature of 500 ^{0}C at 3 hour time intervals to remove thermal strain. All glass samples shows yellow color. The results found that, from x-ray diffraction pattern was used to confirmed amorphous nature of glass samples.

5.2 Density and Molar Volume

The density is not depends on Dy_2O_3 concentration, although the relative molecular mass of Dy_2O_3 is higher than boric oxides (B_2O_3).

In this case, when add Dy_2O_3 in bismuth borate glasses. The loose packing increases due to Dy_2O_3 acts as modifier. The NBOs are increased in number in the borate network, so molar volumes were increased**.** The increases in the molar volume is due to the increasing in the bond length or inter-atomic spacing between the atoms which may be attributed to the decrease in the stretching force constants of the bonds inside the glass network**.**

5.3 UV-VIS-NIR Absorption Study

From optical spectra, there were six absorption peaks from the ground state $^6H_{15/2}$ to energy level $^6F_{3/2}$ (762 nm), $^6F_{5/2}$ (805 nm), $^6F_{7/2}$ (905 nm), ($^6H_{7/2}$, $^6F_{9/2}$) (1,100 nm), ($^6F_{11/2}$, $^6H_{9/2}$) (1,280 nm), and $^6H_{11/2}$ (1,695 nm). In the case of Dy^{3+} ($^4f_9$) ions, the hypersensitive transition ($^6F_{11/2}$, $^6H_{9/2}$) is found to be more intense than the other transitions.

5.4 Luminescence Properties

From this emission spectra, three emission transitions were observed, which are assigned to $^4F_{9/2}\rightarrow{}^6H_{15/2}$ (484 nm, 2.56 eV), $^4F_{9/2}\rightarrow{}^6H_{13/2}$ (574 nm, 2.16 eV), and $^4F_{9/2}\rightarrow{}^6H_{11/2}$ (661 nm, 1.88 eV) (for blue, yellow, and red bands) transitions, respectively. All intensity of emission peaks are comparables with different Dy_2O_3 concentration.

Generally, In the case of Dy^{3+} luminescence, the intensity ratio of yellow and blue transitions has been used to measure the symmetry of the local environment of the trivalent 4f ions. The greater the intensity of the yellow transition, indicated more asymmetric the nature in the glass matrix. In the present work, $^4F_{9/2}\rightarrow{}^6H_{13/2}$ (yellow band) transition of Dy^{3+} ions is more intense than $^4F_{9/2}\rightarrow{}^6H_{15/2}$ (blue band), as a result, the studied glasses possess more asymmetry in nature.

From x-ray luminescence spectra, all samples emitted a luminescence with the emission peaks at 480 nm, 575 nm, 660 nm, and 750 nm. The emission spectra peaks were due to the $^4F_{9/2}\rightarrow{}^6H_{15/2}$ (480 nm), $^4F_{9/2}\rightarrow{}^6H_{13/2}$ (575 nm), $^4F_{9/2}\rightarrow{}^6H_{11/2}$ (660 nm), and $^4F_{9/2}\rightarrow{}^6H_{9/2}+{}^6F_{11/2}$ (750 nm), respectively. The x-ray luminescence intensities of peak at 575 nm are slightly increased with increasing of Dy_2O_3 concentration and the strongest intensity peak at 575 nm was obtained, similar with photoluminescence result. From proton luminescence, the emission peak at 575 nm was obtained. This result corresponds with photoluminescence and x-ray luminescence spectra.

All of these results indicated that the utilization of $^4F_{9/2}\rightarrow{}^6H_{13/2}$ transition around 575 nm from photo, x-ray, and proton luminescence. This glass samples can be used for luminescence materials application with strong yellow luminescence. In addition, the scintillation properties were confirmed and possible to develop glass scintillator in future.

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